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INFORMAL REPORT

INSTALLATION ASSESSMENT REPORT FOR EG&G IDAHO, INC., OPERATIONS AT THE IDAHO NATIONAL ENGINEERING LABORATORY

EG&G Idaho

Work performed under DOE Contract No. DE-AC07-76ID01570

EG&G-WM-6875

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FOR EG&G IDAHO, INC.
OPERATIONS AT THE
IDAHO NATIONAL ENGINEERING LABORATORY

Published
January 1986

EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Idaho Operations Office
Under DOE Contract No. DE-AC07-76ID01570

SUMMARY

This report identifies past hazardous waste activities at facilities within the INEL which are now operated or controlled by EG&G Idaho, Inc. The purpose of the report is to identify sites within the INEL where hazardous substances may have been deposited and which may pose potential hazards to health, safety, and the environment as a result of migration of the hazardous substances. This report represents the first step in a systematic approach to dealing with such sites.

The waste disposal sites were identified primarily through review of existing reports and documentation, visual inspections, and interviews with INEL personnel. Any significant sites identified were numerically scored, using the EPA Hazard Ranking System (HRS) for sites with chemical contamination and the DOE Modified HRS (MHRS) for sites with radioactive contamination. Sites with both types of contamination received two scores, with the higher of the two being the score used for ranking. The maximum score possible under either system is 100, and EPA has established an HRS score of 28.5 as a general criterion for inclusion of a site on the National Priority List. This report describes and scores fifty different sites, which are presented according to their scores in Table 1.

Conclusions and recommendations are provided on each of the sites. The primary recommendation to be made is whether the individual site warrants additional study; recommendations as to specific monitoring to be done during the next phase of study are also provided. Sites are described in this report independent of when they received hazardous wastes. Several of the sites will be required to be closed under RCRA regulations because they received hazardous wastes after November 19, 1980 and will be deleted from further study under the DOE CERCLA Program for this reason. Other sites will be addressed as RCRA, Section 3004(u), remedial action sites. These, however, will remain under the DOE CERCLA Program as it is assumed that the Section 3004(u) requirements will closely parallel those of the CERCLA effort. Table 2 provides a list of those sites for which additional study is recommended. It also provides a summary of measures proposed for the next step of the long-range program.

TABLE 1. HAZARD RANKING SCORES FOR EG&G SITES

Site	High Score	HRS	MHRS
TRA Warm-Waste Leach Pond	51.9	51.9	51.9
TRA Warm-Waste Retention Basin	41.9	22.0	41.9
TRA Waste Disposal Well	39.9	39.9	0
TSF Injection Well	31.6	31.6	9.2
CFA Landfill	17.7	17.7	0
WRRTF Injection Well	14.5	14.5	1.3
ARA-II SL-1 Burial Ground	13.7	0	13.7
TRA Chemical Waste Pond	12.0	12.0	0
PBF Corrosive-Waste Injection Well (PBF-302)	12.0	12.0	0
CF-674 Pond	12.0	12.0	0
TSF RPSSA/TSF-1 Area	11.4	0	11.4
TSF Disposal Pond	10.5	10.5	3.2
ARA-III Radioactive-Waste Leach Pond	10.5	10.5	5.8
ARA-III Sanitary Sewer Leach Field (ARA-740)	10.0	10.0	0
TSF TAN-607 Mercury Spill	9.5	9.5	0
IET Injection Well (TAN-332)	9.5	9.5	0
Minor spills at TRA Open Loading Dock (TRA-722)	9.2	9.2	0
RWMC	9.0	9.0	9.0
CFA Motor Pool Pond	8.5	8.5	0
OMRE Leach Pond	7.8	7.1	7.8
CFA Sewage Drain Field	7.8	0	7.8
CF-633 French Drain	7.8	7.8	0

TABLE 1. (continued)

Site	High Score	HRS	MHRS
TSF TAN-607 Fuel Spill	7.3	7.3	0
LOFT TAN-629 Diesel Fuel Spills	7.3	7.3	0
TRA Acid Spill (TRA-608)	7.1	7.1	0
TRA Paint Shop Ditch (TRA-606)	7.1	7.1	0
EOCR Leach Pond	7.1	7.1	0
TSF Service Station Spill (TAN-664)	6.8	6.8	0
WRRTF Burn Pit	6.8	6.8	0
WRRTF Two-Phase Pond (TAN-763)	6.3	6.3	0
LOFT Disposal Pond (TAN-750)	6.3	6.3	5.8
SPERT I Corrosive-Waste Seepage Pit (PBF-750)	6.0	6.0	0
NODA	5.9	5.9	0
TSF Burn Pit	5.8	5.8	0
WRRTF Evaporation Pond (TAN-762)	5.3	5.3	0
ARA-I Chemical Leach Field (ARA-745)	5.3	5.3	0
SPERT-III Small Leach Pond	5.0	5.0	0
SPERT IV Leach Pond (PBF-758)	5.0	5.0	0
WRRTF Radioactive Liquid Waste Tank (TAN-735)	4.6	0	4.6
SPERT II Leach Pond	4.5	4.5	0
PBF Warm-Waste Injection Well (PBF-301)	4.2	0	4.2
PBF Evaporation Pond (PBF-733)	4.0	4.0	0
TSF Gravel Pit	3.8	3.8	0
BORAX II-V Leach Pond	3.8	3.8	2.4
LCCDA	3.7	3.7	0

TABLE 1. (continued)

Site	High Score	HRS	MHRS
TSF Intermediate-Level (Radioactive) Waste Disposal System	3.4	3.4	2.7
BORAX-I Burial Site	2.5	0	2.5
IET Hot-Waste Tank (TAN-319)	2.4	2.4	0.1
ARA I Sanitary Waste Leach Field	1.6	0	1.6
ARA-I Pad Near ARA-627	0.3	0	0.3
IET Septic Tank	0	0	0

TABLE 2. RECOMMENDED MONITORING PROGRAM FOR EG&G FACILITIES UNDER PHASE II OF THE DOE CERCLA PROGRAM

Site	Rating Score		Recommended Monitoring
TRA			
1. TRA Warm-Waste Leach Pond	51.9	1.1	Sample and profile contaminants in pond sediments
		1.2	Improve and continue local sampling of perched water table and Snake River Plain Aquifer
		1.3	Evaluate appropriateness of existing monitoring wells to detect Contaminant migration
2. TRA Warm-Waste Retention Basin	41.9	2.1	Recommendations 1.2 and 1.3 also apply to this site
3. TRA Waste Disposal Well	39.9	3.1	No specific recommendations are made, 1.2 and 1.3 also apply
4. TRA Open Loading Dock (TRA-722)	9.2	4.1	Sampling survey of soil beneath dock
TAN/TSF			
5. TSF Injection Well	31.6	5.1	Improve and continue local monitoring of Snake River Plain Aquifer.
		5.2	Evaluate appropriateness of existing monitoring wells to detect contaminant migration
6. RPSSA/TSF-I Area	11.4	6.1	Ground penetrating radar survey for buried objects
		6.2	Soil sampling to characterize potential mercury spill near HTRE-3 motor, including railroad tracks.
7. TSF Disposal Pond	10.5	7.1	Sampling survey of pond sediments
		7.2	Recommendations 5.1 and 5.2 also apply to this site
8. Mercury Spill (TAN-607)	9.5	8.1	Soil sampling to verify presence/absence and extent of any mercury contamination (include TAN Hot Shop).
9. TSF Burn Pit	5.8	9.1	Surface soil or core samples to verify presence/absence of persistent contaminants
TAN/IET			
10. IET Injection Well	9.5	10.1	Attempt direct monitoring of well
		10.2	Recommendation 5.2 applies
TAN/WRRTF			
11. WRRTF Injection Well	14.5	11.1	Recommendation 5.2 applies
12. WRRTF Burn Pit	6.8	12.1	Surface soil sampling to verify presence/absence of persistent contaminants

TABLE 2. (continued)

Site	Rating Score	Recommended Monitoring
13. Evaporation Pond	5.3	13.1 Sampling survey of pond sediments
ARA		
14. ARA III Radioactive-Waste Leach Pond	10.5	14.1 Sampling survey of pond sediments
15. ARA I Chemical Leach Field	5.3	15.1 Sampling survey of pond water and sediments
16. ARA I Sanitary Waste Leach Field	1.6	16.1 Site characterization for rad contamination only
17. ARA I Pad	0.3	17.1 Site characterization for rad contamination only
PBF		
18. PBF Corrosive-Waste Injection Well	12.0	18.1 Improve and continue local monitoring of Snake River Plain Aquifer 18.2 Evaluate appropriateness of existing monitoring wells to detect contaminant migration
19. SPERT I Corrosive Waste Seepage Pit	6.0	19.1 Soil sampling to verify presence/absence of persistent contaminants
20. SPERT III Leach Pond	5.0	20.1 Sampling survey of pond sediments
21. SPERT IV Leach Pond	5.0	21.1 Sampling survey of pond sediments
22. SPERT II Leach Pond	4.5	22.1 Sampling survey of pond sediments
23. PBF Warm-Waste Injection Well	4.2	23.1 Recommendation 5.2 applies
EOCR		
24. Leach Pond	7.1	24.1 Sampling survery of pond sediments
BORAX		
25. BORAX II-V Leach Pond	3.8	25.1 Sampling survery of pond sediments
LCCDA		
26. LCCDA	3.5	26.1 Soil sampling to verify presence/absence of persistent contaminants

TABLE 2. (continued)

Site	Rating Score	Recommended Monitoring
MUNITIONS/ORDNANCE AREAS		
27. NODA Storage Area	5.9	27.1 Sampling survey of soil where wastes were once stored
28. Miscellaneous Munitions/Ordnance	Unscored	28.1 Pursue having DOD accept responsibility for their old materials or annual surveys of small areas
CFA		
29. CF-674 Pond	12.0	29.1 Sampling survey of old pond sediments
30. CFA Sewage Drain Field	7.8	30.1 Auger sampling of various locations within the drain field
RWMC		
31. RWMC	9.0	31.1 Install new wells to monitor perched water tables 31.2 Evaluate appropriateness of existing aquifer monitoring wells to detect contaminant migration

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1. INTRODUCTION

1.1 Background

The Department of Energy (DOE) has long been engaged in a variety of operations at the Idaho National Engineering Laboratory (INEL), as well as at other sites that generate hazardous substances. In some cases, the migration of these materials may have resulted in the need for remedial actions. These circumstances, coupled with the enactment of environmental legislation and regulations, require that environmentally responsible action be taken to identify and reduce or eliminate potential hazards related to disposal activities. DOE policy is to identify and evaluate potential problems associated with inactive hazardous waste disposal sites at DOE facilities, to control the migration of hazardous substances from such facilities, and to minimize potential hazards to health, safety, and the environment that result from those operations.

A systematic, structured program to look at past disposal operations has been developed by DOE for implementation at facilities under their control. The program consists of five phases:

1. Phase I--Installation Assessment: To locate and identify those inactive hazardous waste disposal sites that may pose an undue risk to health, safety, and the environment as a result of migration of hazardous substances.

2. Phase II--Confirmation: To quantify by preliminary and comprehensive environmental survey, the presence or absence of hazardous substances that may have an undue risk to health, safety, and the environment.

3. Phase III--Engineering Assessment: To develop, evaluate, and recommend a plan for controlling the migration of hazardous substances or effecting remedial actions at the installation.

4. Phase IV--Remedial Actions: To implement the recommended site-specific remedial measures identified in Phase III. This includes the engineering, design, and actual construction of barriers to restrain migration of identified hazardous substances or decontamination operations.

5. Phase V--Compliance and Verification: To prepare remedial action documentation and establish any monitoring requirements.

1.2 Authority

The national program to identify and correct problems generated from old disposal sites was initiated by passage of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. CERCLA provides that owners and operators of facilities from which a release has occurred shall be liable for response costs incurred and for damages to natural resources. The act also authorizes the government to take necessary response actions when the actual or threatened release of hazardous substances may endanger public health or the environment, and to recover the costs thereof from responsible parties.

In response to the national effort, DOE has established, through DOE Order 5480.14, its own CERCLA program. The order, entitled "Comprehensive Environmental Response, Compensation, and Liability Act Program," provides guidance and instructions to implement a program, defines actions to identify and evaluate inactive hazardous waste disposal sites on DOE installations, and effects remedial actions to control the migration of hazardous substances resulting from such sites. The order applies to all DOE elements and all contractors performing work for DOE as provided by law and/or contract and as implemented by the appropriate contracting officer. The five-phased program described in Section 1.1 is established in this order, as is a tentative schedule for the completion of each phase.

1.3 Purpose

The purpose of this report is to provide the results of the Phase I--Installation Assessment effort for certain operations performed for DOE at the INEL. As stated previously, the purpose of the Installation Assessment is to locate and identify those inactive hazardous waste disposal sites that may pose an undue risk to health, safety, and the environment as a result of migration of hazardous substances. Recommendations of sites to receive additional study or to be dropped from consideration are presented for DOE approval or disapproval.

1.4 Scope

The Installation Assessment described by this report addresses inactive hazardous waste disposal sites within the INEL. These sites are a result of: (a) operations performed by EG&G Idaho while under contract to DOE, (b) operations performed by previous site services contractors, or (c) operations performed by other DOE contractors at sites where they no longer operate and for which facility/property management has been accepted by the site services contractor.

1.5 Methodology

Methodology for the Installation Assessment is provided in DOE Order 5480.14, as is the decision tree that is shown in Figure 1.1. The steps outlined in the decision tree were followed as described below.

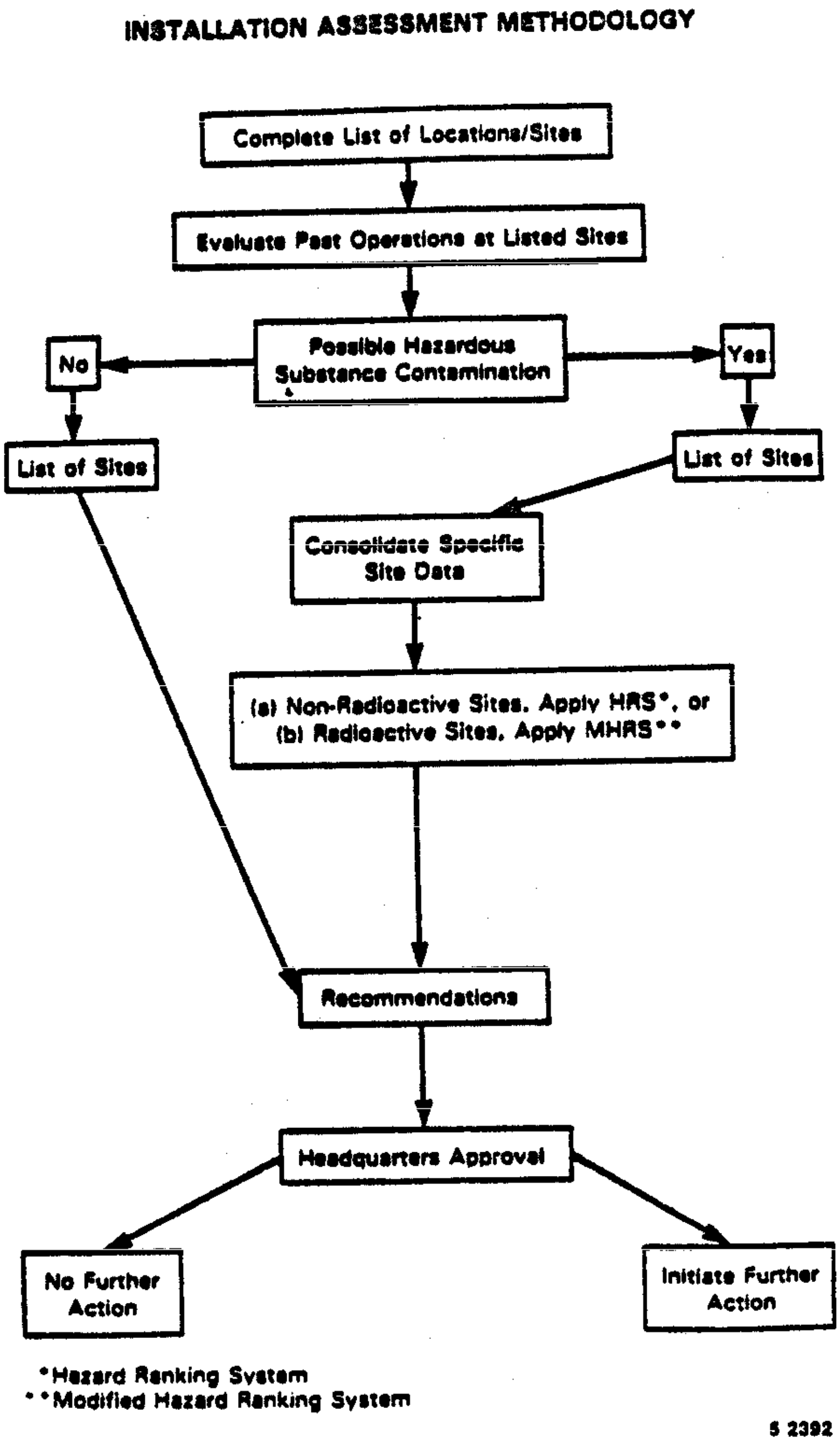


Figure 1.1. Decision tree for installation assessment methodology.

1.5.1 Generate List of Locations/Sites

Interviews were conducted with present and former INEL workers who were knowledgeable about past and/or present operations at various Site facilities. Interviews keyed on activities generating waste and on the ensuing disposal practices.

Applicable information about INEL facilities and operations was collected for review and analysis. This information included:

1. Site-specific National Environmental Policy Act documentation. The Final Environmental Impact Statement on Waste Management Operations at the INEL was of particular value.

2. Environmental monitoring program documentation. Since essentially the beginning of DOE operations at the INEL, the United States Geological Survey (USGS) has monitored the hydrogeology of the Site and the impacts caused by disposal practices. The USGS has published numerous reports characterizing the Site and detailing the results of their monitoring.

3. Effluent and emission monitoring program data. A computerized Industrial Waste Management Information System has been used at the INEL since 1971 to track industrial waste storage and disposal. A similar system, the Radioactive Waste Management Information System, was initiated at the same time to track all types of radioactive waste stored or disposed of at the INEL.

4. Safety analysis documentation. Site safety engineers and their records were an excellent source of information.

5. Investigative reports of accidents and incidents.

6. Reports of hazardous waste spills and other releases.

7. Site maps and photographs.

8. Special and topical reports relevant to waste disposal and environmental pathways. Included in this category of reports were the Long-Range Plans for Decontamination and Decommissioning, Candidate Radioactive Mixed Waste Streams, and the Hazardous Waste Management Implementation Plan.

9. Site development or site management plans and documents. The INEL Facility Master Plan prescribes basic policies and procedures for site development and facility utilization planning.

10. Site history and function. Both the INEL Facility Master Plan and USGS reports on the site provide history and function information.

11. Shipment records. Since the implementation of the Resource Conservation and Recovery Act (RCRA), records have been kept on hazardous wastes that have left the INEL for treatment and/or disposal. These, and other such records, have provided an insight into where wastes are generated.

1.5.2 Evaluate Past Operations

A general evaluation was performed of the sites identified through the information obtained in the first step. The sites were evaluated to determine if there were any possibility of hazardous substance contamination. The evaluation considered management practices involved in the use, storage, treatment and disposal of hazardous substances, as well as any environmental stress or obvious signs of contamination apparent during physical inspection of the sites. All sites considered are identified in the report, but only those where possible hazardous substance contamination exists were considered for the next step.

1.5.3 Rate the Sites

After consolidating specific site data, potentially contaminated sites were ranked using the ranking methodology provided in the Hazard Ranking System (HRS) of 40 CFR 300, Appendix A. The HRS was used to score sites with nonradioactive contaminants. A modified HRS (or MHRS), developed within DOE, was used to rank sites with radioactive contamination. The score for an individual site with both types of contamination was the higher of the two scores obtained by using the two ranking systems. The HRS and MHRS are intended to provide an indication of the relative potential for environmental impact possessed by each site. Recommendations as to whether or not to consider individual sites in the next phase of the DOE CERCLA program are based upon this potential.

2. INSTALLATION DESCRIPTION

2.1 Location

The INEL, formerly the National Reactor Testing Station (NRTS), was established in 1949 by the U.S. Atomic Energy Commission as an area to build, test, and operate various nuclear reactors, fuel processing plants, and support facilities with maximum safety and isolation. In 1974, the NRTS was redesignated as the INEL to reflect the broad scope of engineering activities conducted at the site.

The INEL Site covers approximately 2300 square kilometers (890 square miles) of sagebrush- and basalt-covered land on the Snake River Plain in southeastern Idaho. The nearest INEL boundary is 47 kilometers (29 miles) west of Idaho Falls, 52 kilometers (32 miles) northwest of Blackfoot, 80 kilometers (50 miles) northwest of Pocatello, and 11 kilometers (7 miles) east of Arco. The site encompasses portions of five Idaho counties: Butte, Jefferson,.Bonneville, Clark and Bingham. Figure 2.1 provides a vicinity map of the INEL.

The U.S. Government used portions of the Site prior to its being established as the NRTS. During World War II, the U.S. Navy used about 270 square miles of the Site as a gunnery range. An area southwest of the naval area was once used by the U.S. Army Air Corps as an aerial gunnery range. The present INEL Site includes all of the former military area and a large adjacent area withdrawn from the public domain for use by DOE. The former Navy administration shop, warehouse, and housing area is today the Central Facilities Area of the INEL. These pre-DOE operations will be considered in this report.

There are no permanent residents within the INEL; the nearest populated area is Atomic City (about 35 residents), located less than one mile from the southern INEL boundary. Figure 2.2 shows population distribution around the INEL, with the radii centered in the south-central

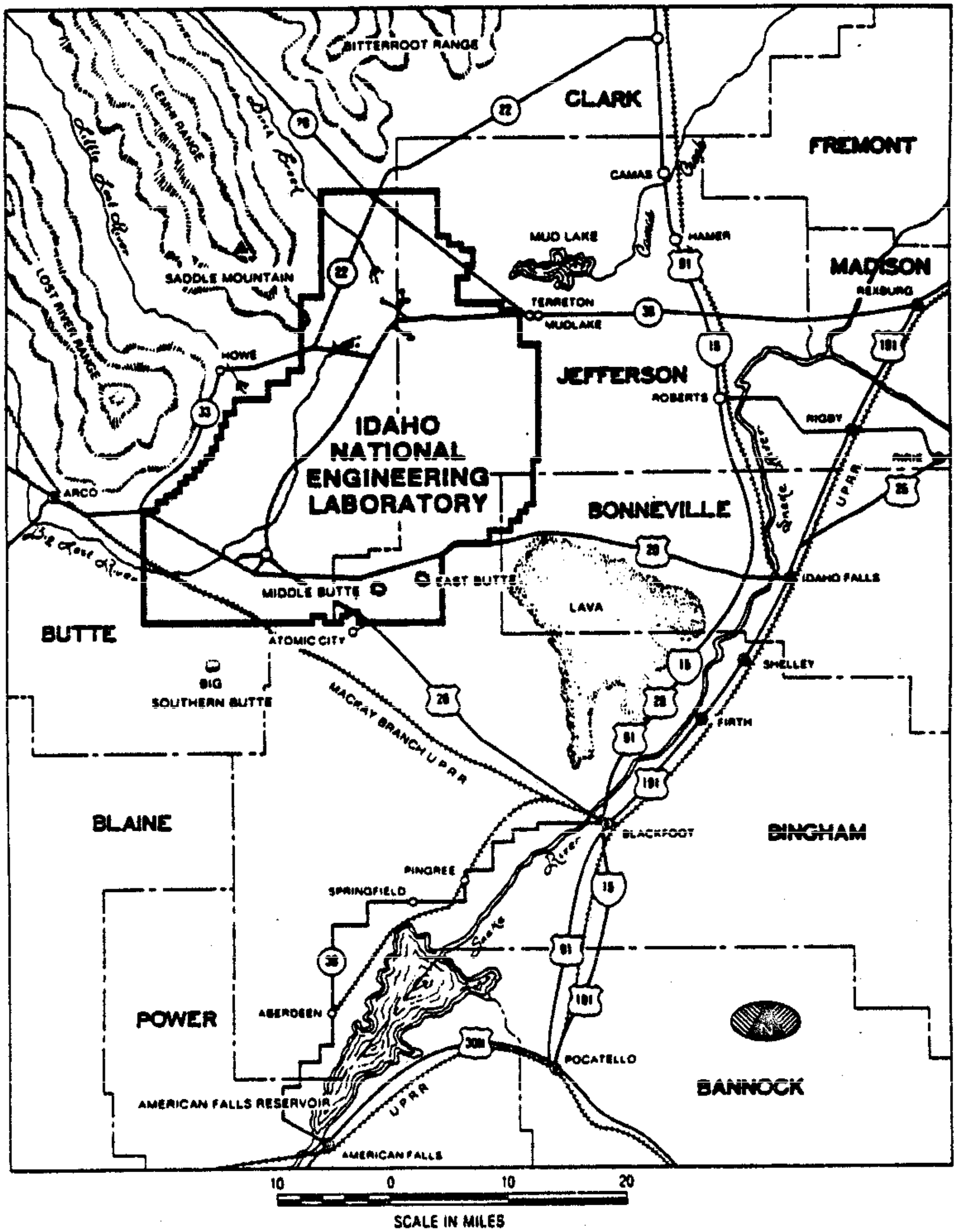
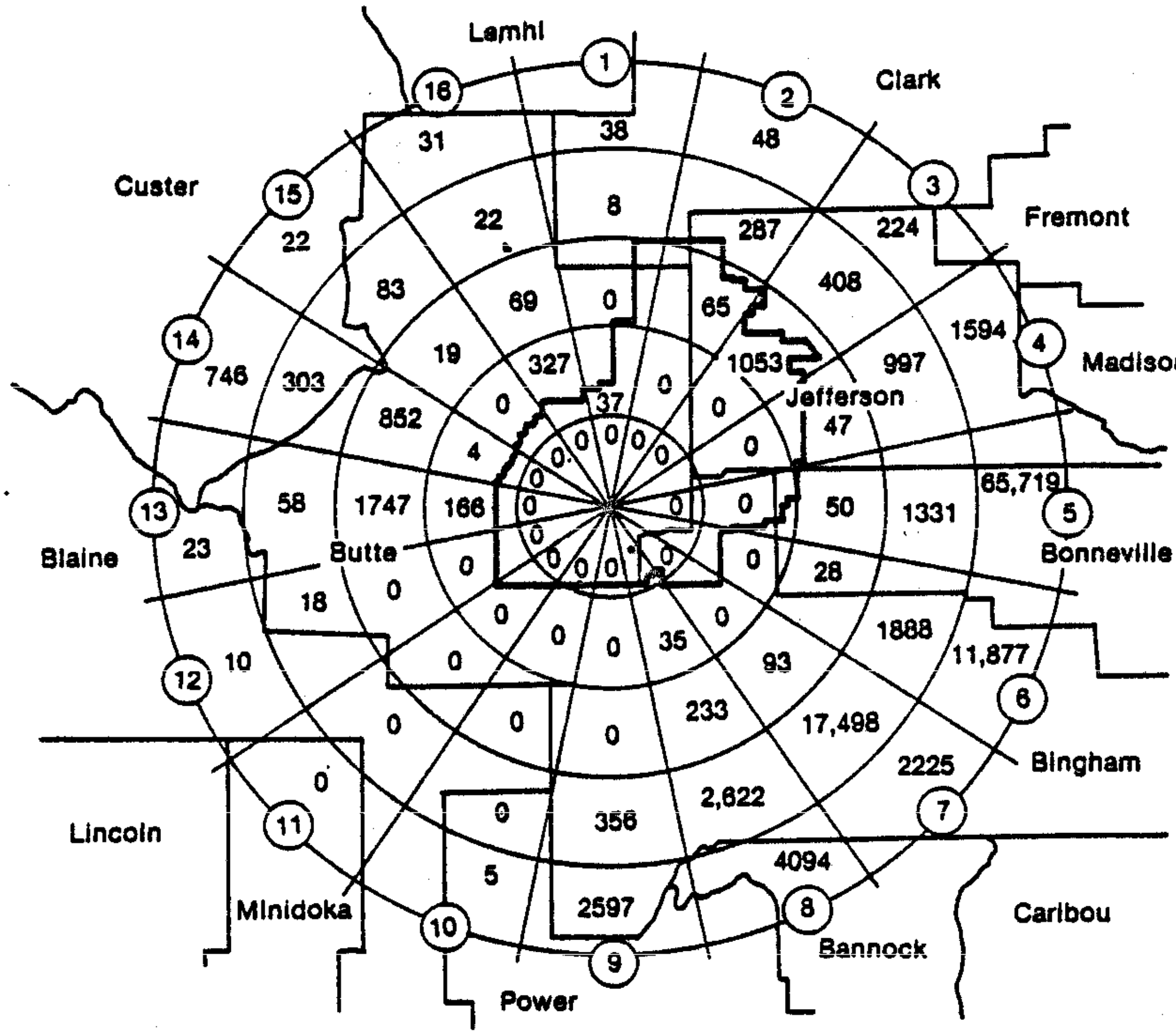


Figure 2.1. INEL Site vicinity map.



*The computer listing of six persons living in this area is erroneous, because of the program's assumption that persons within a given mi^2 section are uniformly distributed in that area. No persons reside in this area.

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Figure 2.2. Human population distribution around the INEL.

portion of the Site in the area of the TRA-ICPP complex. Population estimates are based on the 1980 census, but include a growth prediction by the Idaho Falls Chamber of Commerce of a growth rate of 2.7% per year for the City of Idaho Falls. This projection adds an additional 4,452 people to the fifth sector at the 40- to 50-mile segment through CY 1984. It is assumed that the population in other sectors will remain stable. The population residing within a 30-mile radius is shown in Figure 2.2 to be 4,625, and within a 50-mile radius, 119,957.

As of June 1984, the INEL employed 9986 persons, including both Site and nonsite workers. Approximately 6,500 employees are present at the INEL during the day shift; about 700 are on site during each of the other shifts. These are average numbers that vary with changes in operational requirements and construction work. No one is allowed to reside on the INEL. Employees live in more than 30 communities adjacent to the INEL, the largest percentage residing in Idaho Falls. Contractor-operated bus service is provided from the major communities.

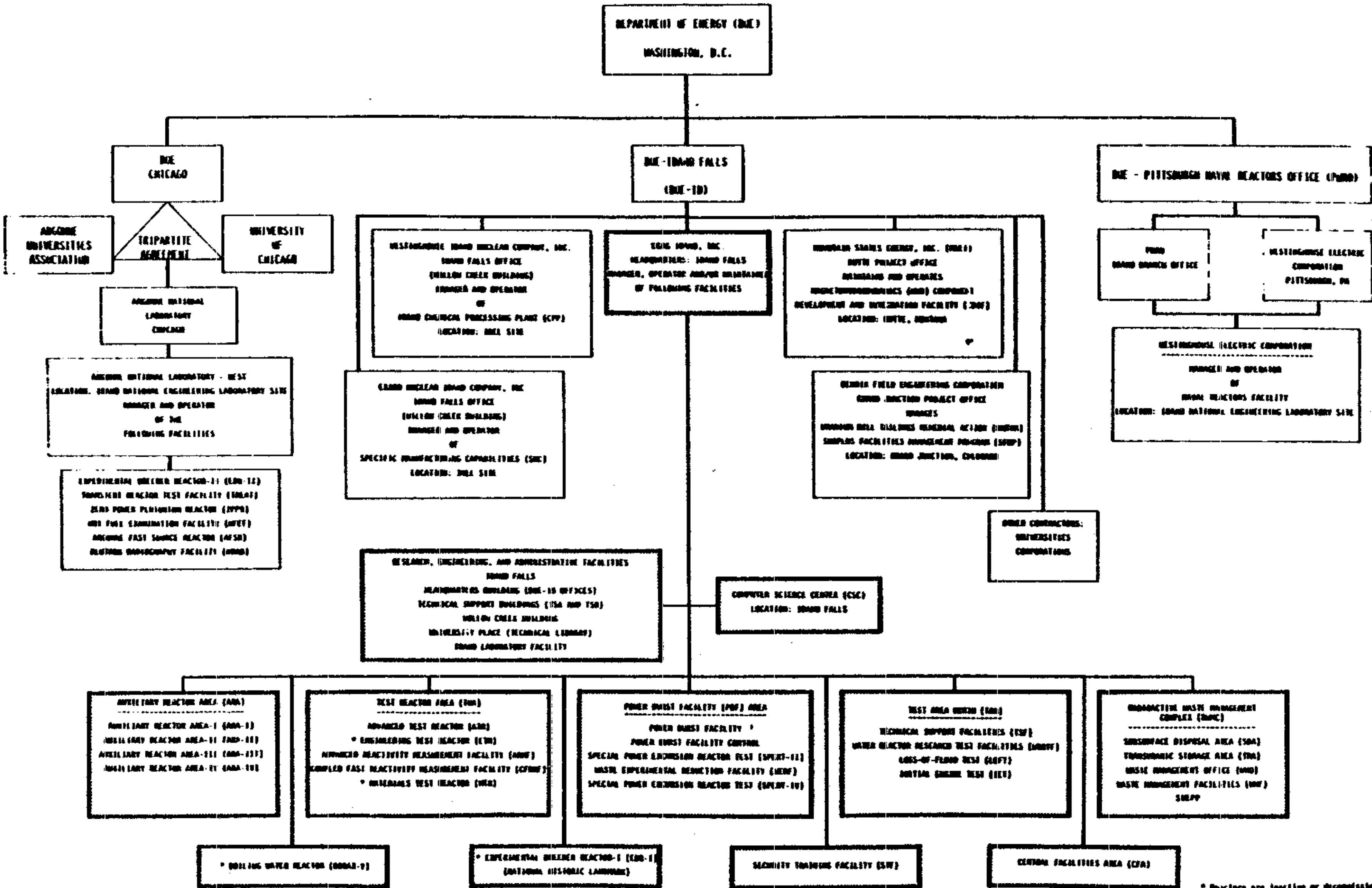
2.2 Organization and Mission Summary

The INEL is a government-owned reservation, or test site, managed by DOE. A large variety of laboratory activities and test facilities support DOE and other government-sponsored research and development programs and projects. Major INEL research and development programs involve fusion energy, geothermal energy, low-head hydropower, industrial energy conservation, strategic and critical materials, code development, materials testing, and instrumentation. The INEL contains the largest concentration of nuclear reactors in the world. Fifty-two reactors, most of them first-of-a-kind, have been built on the Site. Fifteen of these reactors are currently operable, the others have phased out upon completion of their research missions.

Most INEL facilities are operated by one of five government contractors: Argonne National Laboratory-West (ANL-W); EG&G Idaho, Inc. (EG&G); Exxon Nuclear Idaho Company (ENICO); Westinghouse Electric Corporation (WEC); and Westinghouse Idaho Nuclear Company (WINCO). As shown in Figure 2.3, these contractors conduct various programs at the INEL under the administration of three DOE offices: Idaho Operations Office (ID), Pittsburgh Naval Reactors Office (PNRO), and Chicago Operations Office (CH). Another government contractor, American Protective Service, provides security services for the INEL under the administration of DOE-ID. Figure 2.3 also identifies the facilities operated by the primary contractors.

DOE-ID is the INEL Site manager and is responsible for common Site services, Site environmental control and management, and overall Site safety and emergency planning functions. It provides certain of these services directly and the rest through its contractor, EG&G. However, the other DOE program/project operations offices (PNRO and CH) working at the INEL are responsible for activities within their own designated test facility boundaries. DOE-ID performs functions or services at these designated sites only through interface agreements with the other DOE operations offices.

EG&G Idaho is a prime operating contractor and the Site services contractor for the INEL. As such, EG&G provides a variety of programmatic and support services related to nuclear reactor design and development, nonnuclear energy development, materials testing and evaluation, operational safety, and radioactive waste management. EG&G currently operates six research reactors at the INEL and provides all services for total Site operation, including support services to four other contractors. EG&G is also responsible for the management, to include decontamination and decommissioning, of facilities that have completed their research missions. This responsibility encompasses facilities operated by past Site services contractors as well as by EG&G, and also includes facilities operated by other contractors for which the Site services contractor has accepted responsibility. For example, the Boiling Water Reactor Experiment (BORAX) site was operated by ANL-W, but the inactive site is managed by EG&G. (As described in Section 1.4, the scope of this report is limited to those INEL sites currently operated by EG&G



* Reactors are inactive or decommissioned. Either the facility is used for offices or storage, or it is unused.

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Figure 2.3 Organization chart.

and those inactive sites that were either operated by the Site service contractor or for which management responsibilities were accepted by the Site service contractor.)

Along with EG&G, WINCO and ENICO are the INEL operating contractors, performing programs under the administration of DOE-ID. WINCO operates the Idaho Chemical Processing Plant (ICPP) for the reprocessing of enriched "unburned" uranium from spent nuclear fuel elements, mostly from government-owned reactors. ENICO operates a special project for DOE.

ANL-W programs at the INEL are administered by DOE-CH and include the operation of four major facilities with five reactors, all in support of the Liquid Metal Fast Breeder Reactor Program. These facilities are Experimental Breeder Reactor-II, Transient Reactor Test Facility, Zero Power Plutonium Reactor, and Hot Fuel Examination Facility.

WEC manages the Naval Reactor Facility (NRF) at the INEL under the administration of DOE-PNRO. The NRF is used primarily as a base for training U.S. Navy personnel to operate the Navy's nuclear fleet. Included in the NRF are the Submarine Prototype Facility with one reactor, the Large Ship Reactor Facility with two reactors, the Natural Circulation Submarine Prototype Facility with one reactor, and the Expended Core Facility.

Also located at the INEL are facilities for the following:

1. The Radiological and Environmental Services Laboratory of DOE

2. The U.S. Geological Survey

3. The Field Research Office of the National Oceanic and Atmospheric Administration's Air Research Laboratories.

3. ENVIRONMENTAL SUMMARY

3.1 Meteorology

3.1.1 Data Source

The National Oceanic and Atmospheric Administration (NOAA) and its predecessor, the U.S. Weather Bureau, have operated a meteorological observation program at the INEL since 1949. Meteorological data have been collected at over 40 locations on and near the INEL since that time. The weather station at Central Facilities Area (CFA) was the first on-site station and appears on National Climatic Center records as "Idaho Falls 46 W." In addition to recording day-to-day weather data and providing daily operational forecasts for the INEL, the NOAA staff maintains an intensive research and development program to improve the reliability of prediction and measurement of meteorological parameters which influence safe conduct of operations on the INEL. A number of meteorological stations are located throughout the INEL to measure simultaneously the spatial variation of several meteorological parameters such as temperature and wind speed and direction, up to a height of 250 ft.

3.1.2 General Climatology

The location of the INEL in a flat valley surrounded by mountains, its altitude above sea level, and its latitude affect the climate and the day-to-day weather systems. All air masses entering the Snake River Plain first cross a mountain barrier, usually precipitating a large percentage of their moisture. Annual rainfall at the INEL is light, and the region has semiarid characteristics. The local northeast-southwest orientation of the plain and bordering mountain ranges tends to channel prevailing west winds so that a southwest wind predominates over the INEL; the second most frequent winds come from the northeast. The relatively dry air and infrequent low clouds permit intense solar heating of the surface during the day and rapid radiational cooling at night. These factors combine to give a wide diurnal range of temperature near the ground. Due to the moderating influence of the Pacific Ocean, most of the air masses flowing over this area are usually warmer during winter and cooler in summer than air masses flowing at a similar latitude in the more continental climate east of the Continental Divide. The Centennial and Bitterroot Mountain Ranges keep most of the shallow, but intensely cold, winter air masses from entering the ESRP when they move southward from Canada. Occasionally, however, the cold air can spill over the mountains. When this happens, the cold air is then held in the ESRP by the surrounding mountains, and the INEL experiences low temperatures for periods lasting a week or longer.

3.1.3 Meteorological Overview

3.1.3.1 Temperature. Monthly and annual average temperatures for the INEL are provided in Table 3.1. Average monthly maximum temperatures range from 30°C (87°F) in July to -2°C (28°F) in January. Average monthly minimum temperatures range from 9°C (49°F) in July to -16°C (4°F) in January. The warmest temperature recorded was 38°C (101°F) and the coldest up through January 1982 has been -40°C (-40°F).

3.1.3.2 Wind. Wind directions at the INEL are mostly from the southwest or northeast quadrants, due to airflow channeling by the bordering mountains. During the summer months a very sharp diurnal reversal in wind direction occurs. Winds blowing from the southwest (upslope) predominate during daylight hours, and northeasterly winds persist at night. Winter winds are controlled almost exclusively by either large scale weather systems or by stagnation, which show no significant diurnal characteristics. The record of average wind speeds shows a minimum of about 2.2 m/s (5 mph) in December and maximum of 4 m/s (9 mph) in April and May. The highest maximum hourly average speed was 23 m/s (51 mph--measured at the 20-ft level at CFA) from the west-southwest. Peak gusts of 35 and 39 m/s (78 and 87 mph) were observed. Calm conditions prevail 11% of the time. Figure 3.1 provides seasonal wind roses as measured at CFA.

TABLE 3.1. PERIOD OF RECORD MONTHLY AND ANNUAL TEMPERATURE AVERAGES AND EXTREME AVERAGES[a]

	Maximum (°F)			Average (°F)			Minimum (°F)		
	High	Average	Low	High	Average	Low	High	Average	Low
January	37.9	27.6	19.5	25.1	15.8	6.5	13.1	3.8	-8.8
February	45.9	34.0	25.6	34.2	21.6	9.9	22.4	9.1	-6.5
March	51.5	42.9	33.6	37.5	30.7	19.1	24.6	8.4	4.5
April	64.7	55.3	46.1	45.9	41.3	35.4	32.0	27.2	22.5
May	76.1	66.3	59.9	58.3	51.3	46.7	40.7	36.2	33.3
June	85.3	76.1	69.9	67.5	59.9	56.2	49.7	43.7	40.4
July	91.2	87.0	82.5	71.8	68.2	66.1	53.1	49.3	46.5
August	90.2	84.8	75.4	70.2	65.9	60.3	53.4	47.1	43.2
September	81.2	73.4	64.1	61.1	55.5	48.6	45.2	37.4	31.9
October	67.7	60.5	53.7	49.2	43.5	38.2	32.1	26.5	21.2
November	50.7	42.5	37.8	36.4	29.9	24.5	24.3	17.3	10.3
December	37.1	31.2	22.3	26.8	19.6	10.2	17.6	7.5	-1.9
ANNUAL	59.5	59.0	53.8	44.3	41.8	39.1	29.9	28.1	24.0

a. Based on National Weather Service (NWS) archived CFA data from April 1954 through December 1982.

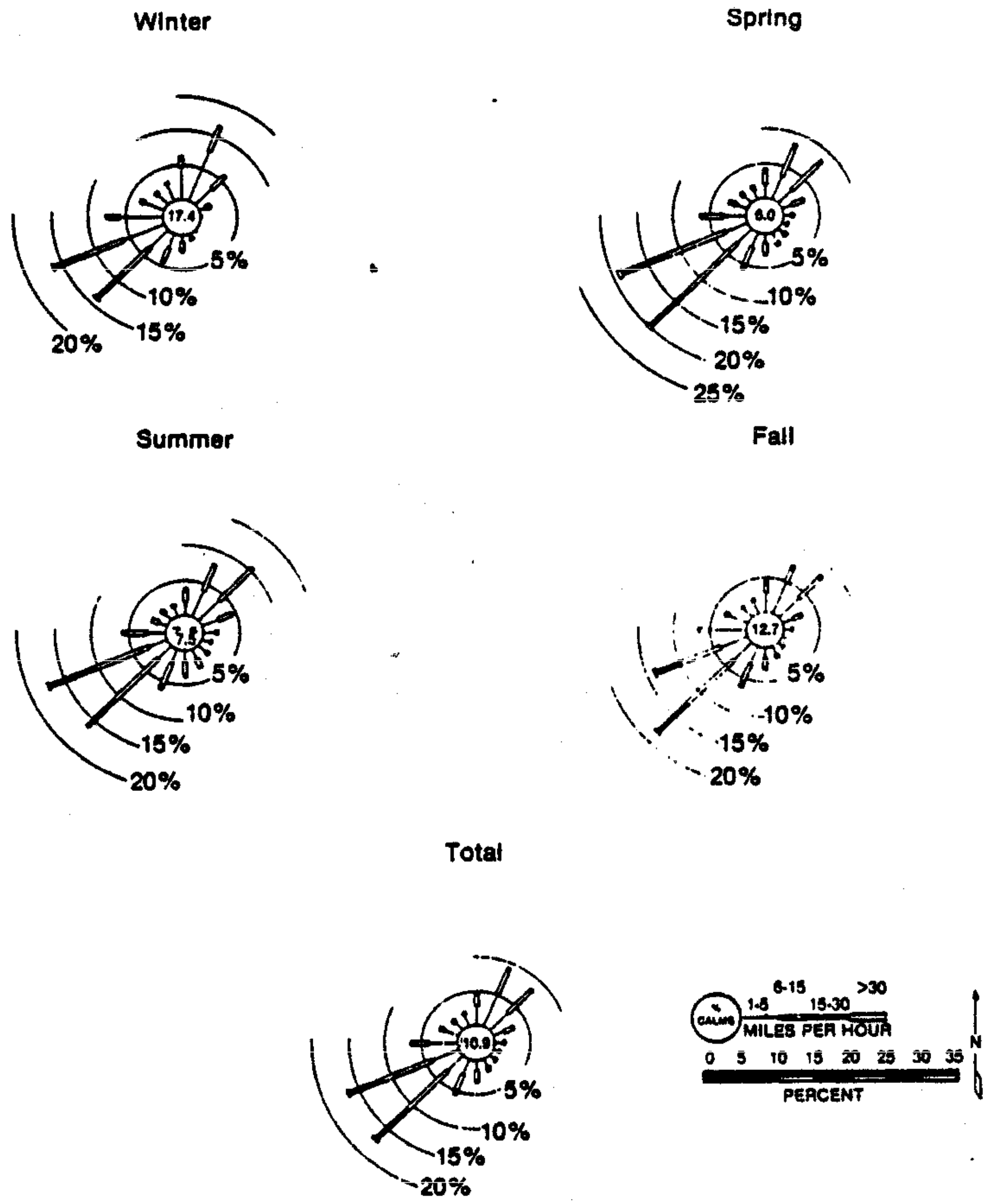

Figure 3.1. CFA 20-ft-level wind roses (January 1950-May 1962).

3.1.3.3 Precipitation. The average annual precipitation is 9.07 in. of water. The yearly totals range from 4.50 to 14.40 in. Individual months have had as little as no precipitation to as much as 4.42 in. Maximum observed 24-h precipitation amounts are less than 2.0 in. and maximum 1-h amounts are just over 1.0 in. Table 3.2 summarizes the average monthly and annual precipitation.

About 26.0 in. of snow falls each year. The maximum yearly total was 40.9 in. and the smallest total was 11.3 in. The greatest 24-h total snowfall was 8.6 in. The greatest snow depth observed on the ground was 27 in. January and February average about 7.0 in. for a monthly maximum depth on the ground. The ground is usually free of snow from mid-April to mid-November.

3.1.3.4 Evaporation. While extensive evaporation data have not been collected on the INEL, evaporation information is available from Aberdeen and Kimberly in southeastern Idaho. These data, which should be representative of the INEL region, indicate that the average annual evaporation rate is about 36 in. About 80% of this (29 in./yr) occurs from May through October.

3.1.3.5 Severe Weather Conditions. On the average, two or three thunderstorm days occur during each of the months from June through August. The surface effects from thunderstorms over the Snake River Plain are usually much less severe than are experienced east of the Rocky Mountains or even in the mountains surrounding the plain. Strong wind gusts can occur in the immediate vicinity of thunderstorms. These gusts are usually quite localized and of short duration. The highest instantaneous speed recorded at 20 ft above the ground was 78 mph from the west-southwest. Although small hail frequently accompanies the thunderstorms, damage from hail has not occurred at the INEL.

Five funnel clouds (vortex clouds which do not reach the ground) and two tornadoes (which caused no damage) have been documented in the 23-yr period of observation at the INEL.

TABLE 3.2. MONTHLY AND ANNUAL PRECIPITATION AT INEL[a]

	Average[b] (in.)	Highest (in.)	Lowest (in.)
January	0.81	2.56	Trace
February	0.64	2.40	0.01
March	0.59	1.44	0.07
April	0.78	2.50	0.00
May	1.28	4.42	0.07
June	1.27	3.89	0.02
July	0.40	1.70	0.00
August	0.56	3.27	Trace
September	0.70	3.52	0.00
October	0.54	1.53	0.00
November	0.65	1.53	0.00
December	0.85	3.43	0.05
ANNUAL[c]	9.07	14.40	4.50
Mean uncertainty in monthly totals[d]	±0.07	±0.12	±0.02

a. From January 1950 through December 1982.

b. Average based on data measured from March 1954 through December 1982.

c. Considers only full calendar year.

d. Based on 1950-1982 values.

3.2 Geology and Soils

3.2.1 Setting

The Snake River Plain is the largest continuous structural element in southern Idaho. It stretches from the Oregon border in a curving arc across Idaho to Yellowstone National Park in northwestern Wyoming. It slopes upward from an elevation of about 2,500 ft at the Oregon border to over 6,500 ft at Henry's Lake near the Montana-Wyoming border. The plain can be roughly divided into eastern and western parts lying east and west of Bliss, Idaho. The Snake River has cut a valley through Tertiary basin-fill sediments and interbedded volcanic rocks from Bliss west to the Oregon border. The stream drainage is well developed except in a few areas covered by recent thin flows of Snake River basalt. East of Bliss the complexion of the plain changes as the Snake River carves a vertical-walled canyon through thick sequences of Quaternary basalt. Drainage on the plain is in a youthful state. The central portion of the plain is generally higher than the north and south edges. The Snake River flows along the southern and southeastern edges of the plain, pushed south by basalt flows.

Located entirely on the northern side of the eastern Snake River Plain, the INEL adjoins mountains to the northwest that comprise the northern boundary of the plain. Three mountain ranges end at the northern and northwestern boundaries of the INEL Site: The Lost River and Lemhi Ranges and the Beaverhead Mountains of the Bitterroot Range, as shown in Figure 3.2. Saddle Mountain, near the southern end of the Lemhi Range, reaches an altitude of 10,795 ft and is the highest point in the area. Figure 3.3. shows Birch Creek, Little Lost River, and Big Lost River all descending southeastward into the Snake River Plain from the mountains adjacent to the INEL.

The part of the plain occupied by the INEL Site may be separated into three minor physical subdivisions: a central trough that extends to the northeast through the Site, and two flanking slopes that descend to the

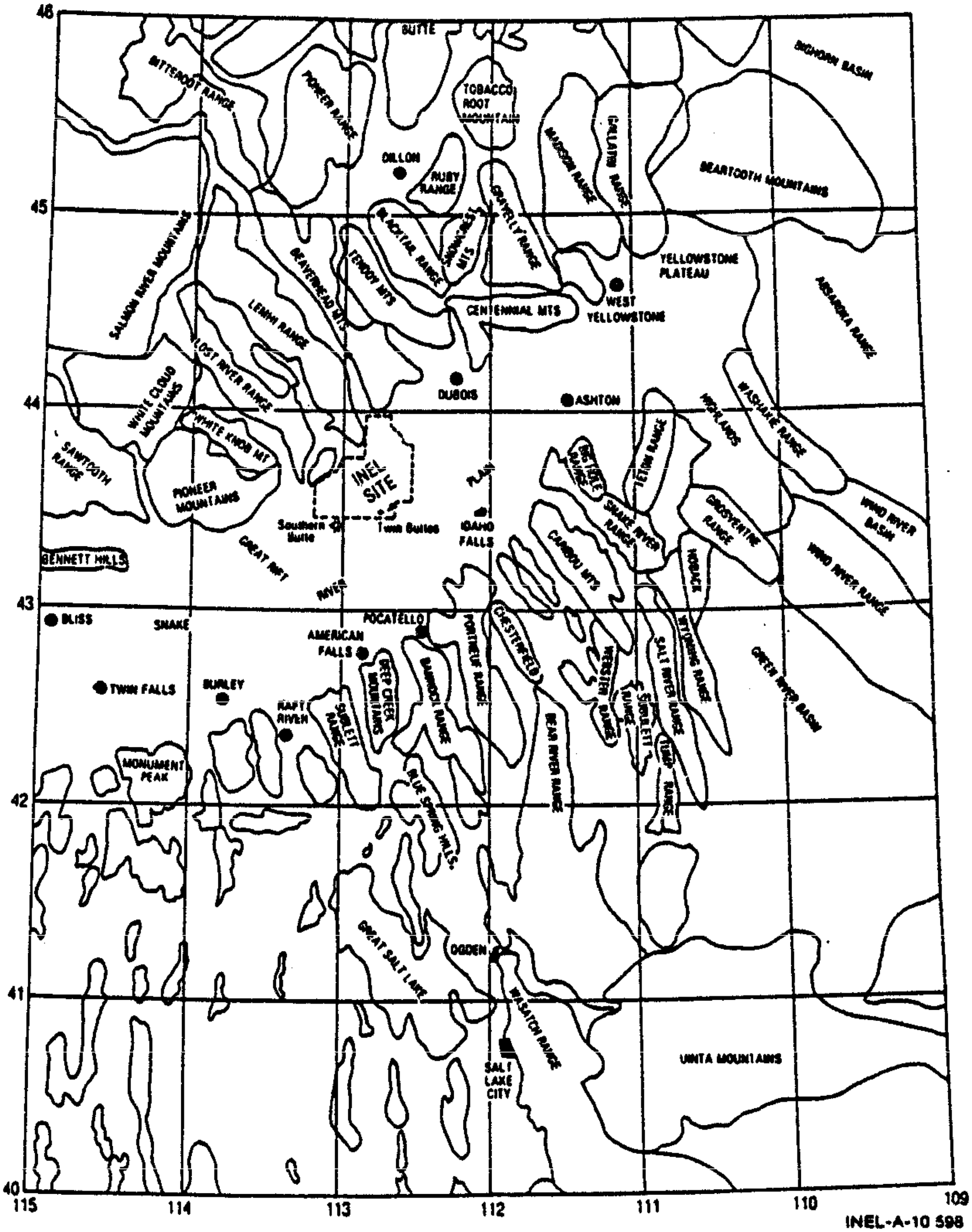

Figure 3.2. Physiography in the region of the INEL.

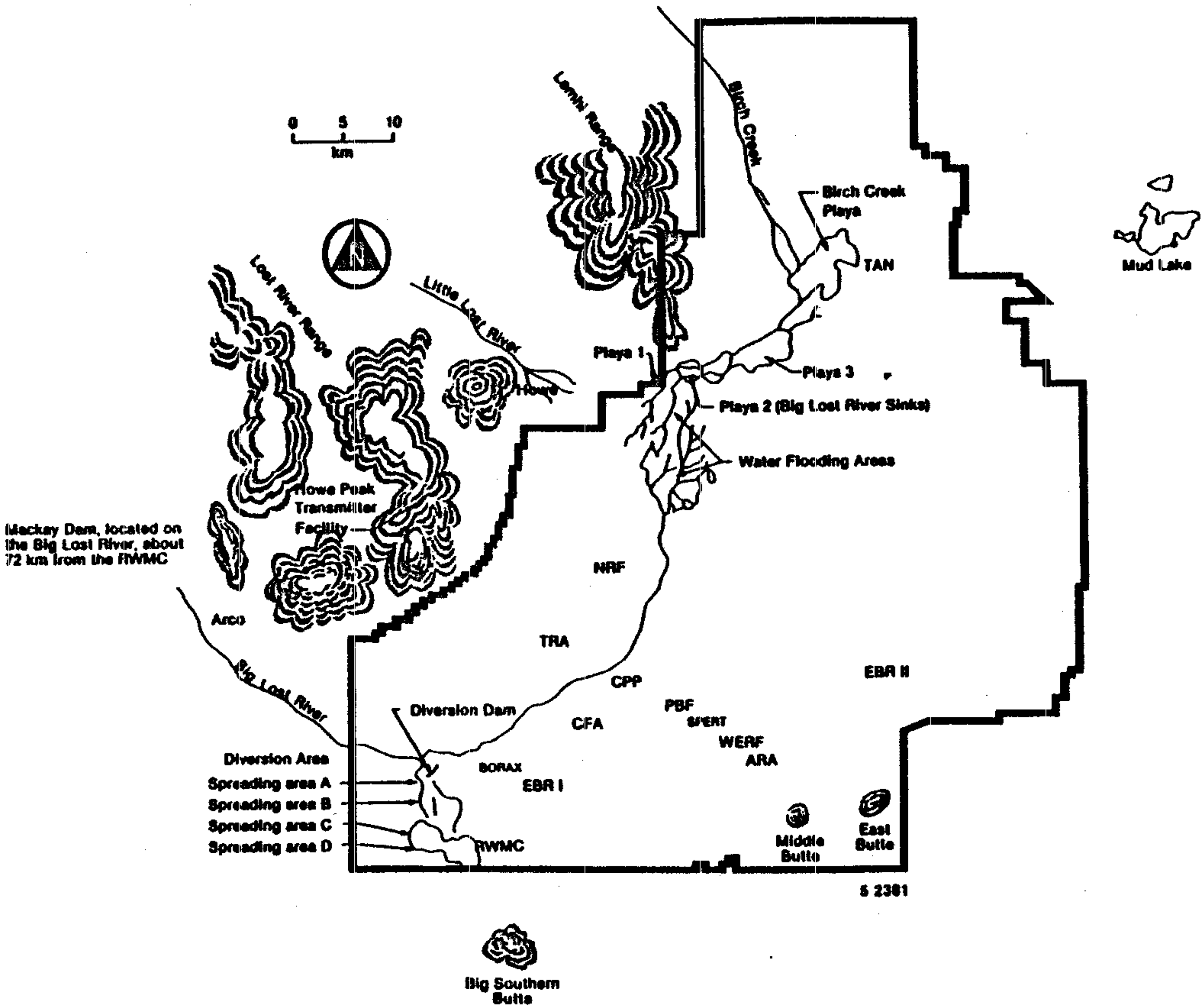

Figure 3.3. Map showing major facilities and surface water features in the vicinity of the INEL.

trough, one from the mountains to the northwest and the other from a broad ridge on the plain to the southeast. The slopes on the northwest flank of the trough are mainly alluvial fans from the mountains and the valleys of Birch Creek and the Little Lost River; however, some basalt flows, as seen in Figure 3.4, like that on the west side of the valley of Birch Creek, have spread from the mountains toward the plain. The slopes on the southeast flank of the trough are basalt flows which spread from an eruption zone that extends northeastward from Cedar Butte. The lavas which erupted along this zone built up a broad topographic swell that pushed the Snake River to the southern and southeastern edges of the plain. Big Southern Butte and Middle and East Buttes are aligned roughly along this zone; however, they are formed of volcanic rocks older than the surface basalts of the plain.

The central lowland of the INEL Site broadens to the northeast and joins the extensive Mud Lake basin. The waters of the Big and Little Lost Rivers and Birch Creek drain into this trough and toward a broad depression between Howe and Circular Butte. The streams flow through playa-like depressions on the INEL where their waters are dissipated by seepage and evaporation. The lowest part of the INEL Site, at an altitude of about 4,755 ft, is in this trough.

3.2.2 Snake River Plain Formation

The Snake River Plain began to form in mid-Tertiary time. The Pleistocene age (the last million or so years) has been marked by sporadic outbursts of lavas, which have led to the accumulation of several thousand feet of basalt on the INEL Site. The basalt is formed chiefly from fluid (low-viscosity--approximately 1 poise), high-temperature (900 to 1,200°C), pahoehoe lavas. The flows have been extruded from rifts and from volcanoes whose locations are rift-controlled. These form layers of hard rock of varying thicknesses, from 10 to 100 ft. The physical characteristics and horizontal distribution of the flows also vary. Unconsolidated material, cinders, and breccia are interbedded with the basalt. The size and pattern of flows, when considered in space and time, indicate that individual flows are small when compared with the entire plain and were separated in time by

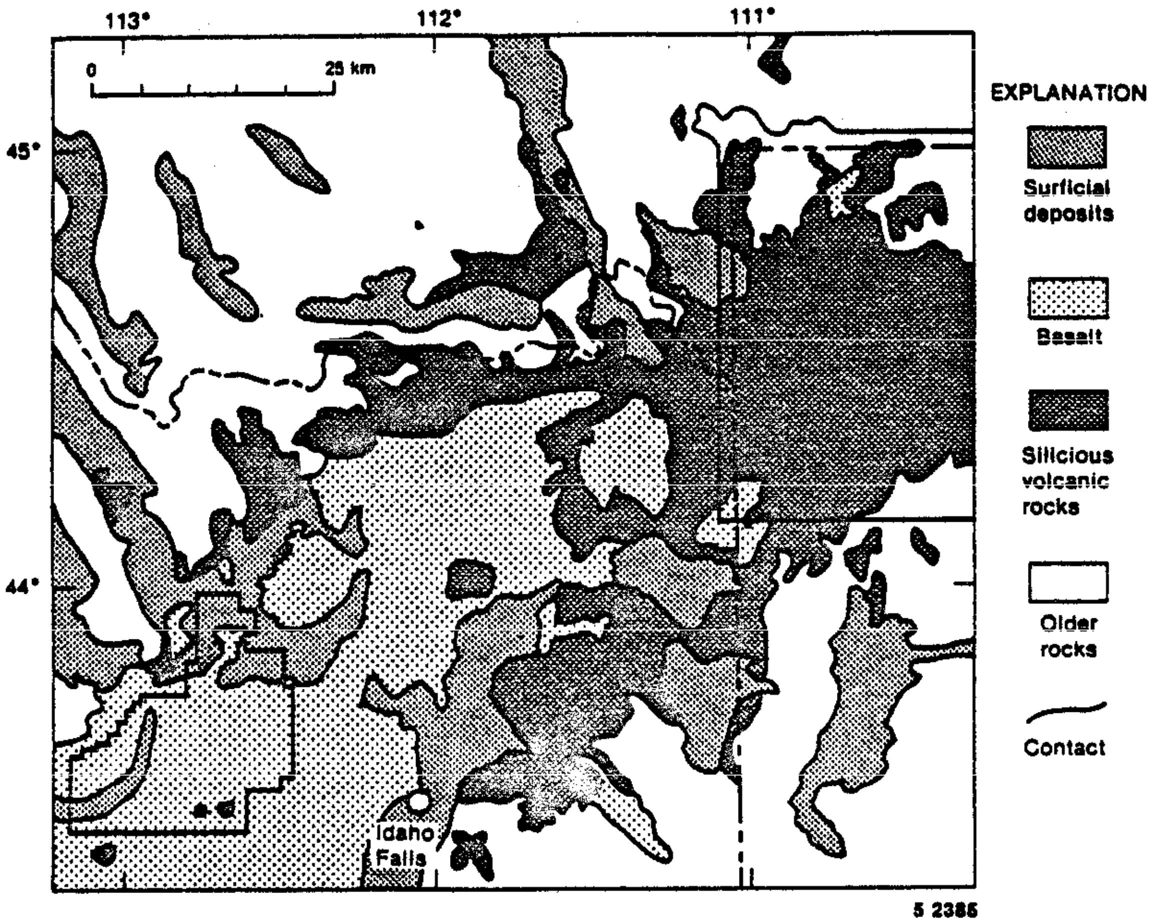

Figure 3.4. Generalized geologic map of the eastern Snake River Plain, Idaho and vicinity.

hundreds or thousands of years. Separate flows are interbedded with sediments of aeolian, lacustrine, and fluvial origins (windblown, lake and stream deposits, respectively).

Thus, underlying the plain are composite layers of interbedded volcanic and sedimentary rocks, principally basaltic lava flow, and interflow beds of sedimentary materials. These layers partly fill a basin of older limestone and volcanic rocks. The older rocks, which are not water-bearing, are exposed in the mountains northwest and southeast of the plain and presumably underlie all of the plain at depths that may be as great as 5,000 ft.

Mountain ranges bordering the plain consist of Mesozoic miogeosynclinal rocks folded during Laramide orogenesis and later uplifted along normal faults during basin and range tectonism. These ranges terminate abruptly against both sides of the low-lying basalt and sediment-filled Snake River Plain. Except for narrow strips of green along the banks of the Snake River where irrigation makes farming practicable, clumps of dry sage cover the plain, interrupted by hummocks of basalt flows. Formation of the plain and filling to an unknown depth with tuffs, lavas, and sediments began in middle Pliocene and apparently continues at present. The last volcanic eruption at Craters of the Moon, 21 kilometers (13 miles) southwest of the INEL Site, occurred about A.D. 400.

3.2.3 Soils

As described previously, a central trough extending northeastward through the INEL Site intercepts the Big and Little Lost Rivers and Birch Creek which descend from the mountain ranges northwest of the Site. The surface soils and mantle rock along the streams are made up of alluvial sands and gravel of varying thicknesses. These grade into more finely textured sediments toward the terminal ends of the streams. The surface soils over the remainder of the INEL are formed by windblown deposits of varying thicknesses. Sandy soils derived from windworked beach and bar deposits formed in old playa lakes or ponds are especially common in the northern part of the INEL. In many places, the basalt is not covered. Local playa areas contain deposits 10 to 15 ft thick. Alluvial fans occur along the mountain fronts.

3.3 Hydrology and Hydrogeology

3.3.1 Surface Water

Most of the INEL is located in the Pioneer Basin, an informally named and poorly defined closed drainage basin. Surface water at the Site consists mainly of streams draining through intermountain valleys to the northwest and into Pioneer Basin. The major streams are the Big Lost River, Little Lost River, and Birch Creek. Refer to Figure 3.3. Local rainfall and snowmelt contribute to surface water, mainly during the spring months. Most of the flow from the Little Lost River and Birch Creek is diverted for irrigation purposes prior to reaching the INEL. However, in very high flow years, Birch Creek flows into the Birch Creek Playa (Playa 4 in Figure 3.3) on the north end of the INEL and infiltrates into the subsurface.

The Little Lost River flows on site during high-flow years and infiltrates into the subsurface. The flow of Birch Creek is remarkably uniform because it is primarily fed by groundwater inflow. During periods of extremely rapid thawing and runoff, such as happened in the early spring of 1969, water from the Birch Creek drainage can become a flood threat to facilities at Test Area North (TAN) which is on the southeast edge of the Birch Creek Playa. The high runoff in 1969 was caused almost entirely by rapid snowmelt on the lower reach of the Birch Creek valley, not from the discharge of Birch Creek. The flow over Highway 22 was estimated at 14.2 m^3/s (500 cfs) in April 1969. The average discharge for Birch Creek is about 7.03×10^7 m^3/yr (57,000 acre-ft/yr) near Reno, Idaho. The average discharge of Little Lost River, 7 miles northwest of Howe is, about 6.2×10^7 m^3/yr (50,000 acre-ft/yr). For comparison, the Big Lost River discharges an average of 2.6×10^8 m^3/yr (210,800 acre-ft/yr). Birch Creek and Little Lost River have a minimal effect on INEL hydrology. Therefore, most of the interest in surface water at INEL is directed toward the Big Lost River.

The Big Lost River flows southeastward through the Big Lost River Basin past Arco, and passes onto the Eastern Snake River Plain. The river flows onto the INEL near its southwest boundary, curves to the northeast, and flows northward to the Big Lost River Playas (sinks). After entering the plain, the river continuously loses water by infiltration through the channel bottom and sides. Therefore, depending on discharge and infiltration conditions, sometimes flow does not even reach the INEL, and at others it continues as far as Playa 3 or even overflows into Playa 4. As flow approaches Playas 1 and 2, the channel branches into many tributaries, and the flow spreads over several flooding and ponding areas.

Storage and diversion systems on the Big Lost River include Mackay Dam (an earthen structure used primarily for the impoundment of irrigation water) 48 km (30 mi) upstream of Arco, several irrigation diversions between Mackay and the plain, and the INEL flood-diversion dam. The INEL flood-diversion system was built in 1958 to divert high flows on the Big Lost River that might create flood hazards to INEL facilities. This system consists of a small dam which diverts flow from the main river channel into four spreading areas (A, B, C, and D in Figure 3.3). Nearly all flow is diverted during winter months to avoid ice jams in the main river channel. The effectiveness of the INEL flood-control system was calculated in 1972 by the U.S. Geological Survey by means of mathematical models. Results indicated that floods in the Big Lost River would have overflowed the INEL diversion dam about once every 55 years. However, dikes were raised 2 m (6 ft) in January and February 1984, providing a diversion system that will be able to contain a flood with an average return period well in excess of 300 yr.

As part of recent environmental studies for a new facility at the INEL, a detailed flood-routing analysis was conducted for a hypothetical failure of Mackay Dam. Results indicate potential flooding of some locations on the INEL in the event of the probable maximum flood. The analysis determined flood conditions resulting from an assumed inflow to Mackay Reservoir equal to the probable maximum flood for the watershed and subsequent failure of Mackay Dam. The failure made was assumed to be overtopping and subsequent breaching of the earthen structure. Figure 3.5 illustrates the approximate extent of the flood inundation for the probable maximum flood conditions analyzed. It should be noted that Figure 3.5 not only depicts a conservative estimate of the probable maximum flood, but it was accomplished before the INEL flood diversion system was upgraded; a physical change that would increase the system's ability to handle high flows.

3.3.2 Subsurface Water

Figure 3.6 shows that the Snake River Plain aquifer, which flows beneath the INEL, is approximately 330 km (206 mi) long, 48 to 96 km (30 to 60 mi) wide and covers an area of about 24,800 km^2 (9600 mi^2). The aquifer is composed of a series of thin basalt flows interbedded with sediments of aeolian, fluvial, and lacustrine origin. Aquifer permeability consists of intergranular and intercrystalline pore spaces, fractures, fissures, and other voids. The hydraulic properties of the aquifer are not spatially homogeneous and the direction of local groundwater movement is complicated. However, the overall flow pattern is to the south and southwest.

The aquifer could contain 2.5×10^{12} m^3 (2×10^9 acre-ft) of water, of which about 6.2×10^{11} m^3 (5×10^8 acre-ft) are recoverable. The aquifer discharges about 8×10^9 m^3 (6.5×10^6 acre-ft) annually through springs in the area from Milner to Bliss, and from Blackfoot to American Falls Reservoir in the region west of Pocatello. Groundwater pumpage for irrigation totals about 1.8×10^9 m^3 (1.5×10^6 acre-ft) annually. The discharges from the springs significantly contribute to the flow of the Snake River downstream of Twin Falls, Idaho.

Groundwater flows to the south and southwest at 1.5-6 m/day (5-20 ft/day). The average slope of the aquifer is about 0.2% from the northeast to southwest. The aquifer transmissivity, measured in wells on the INEL,

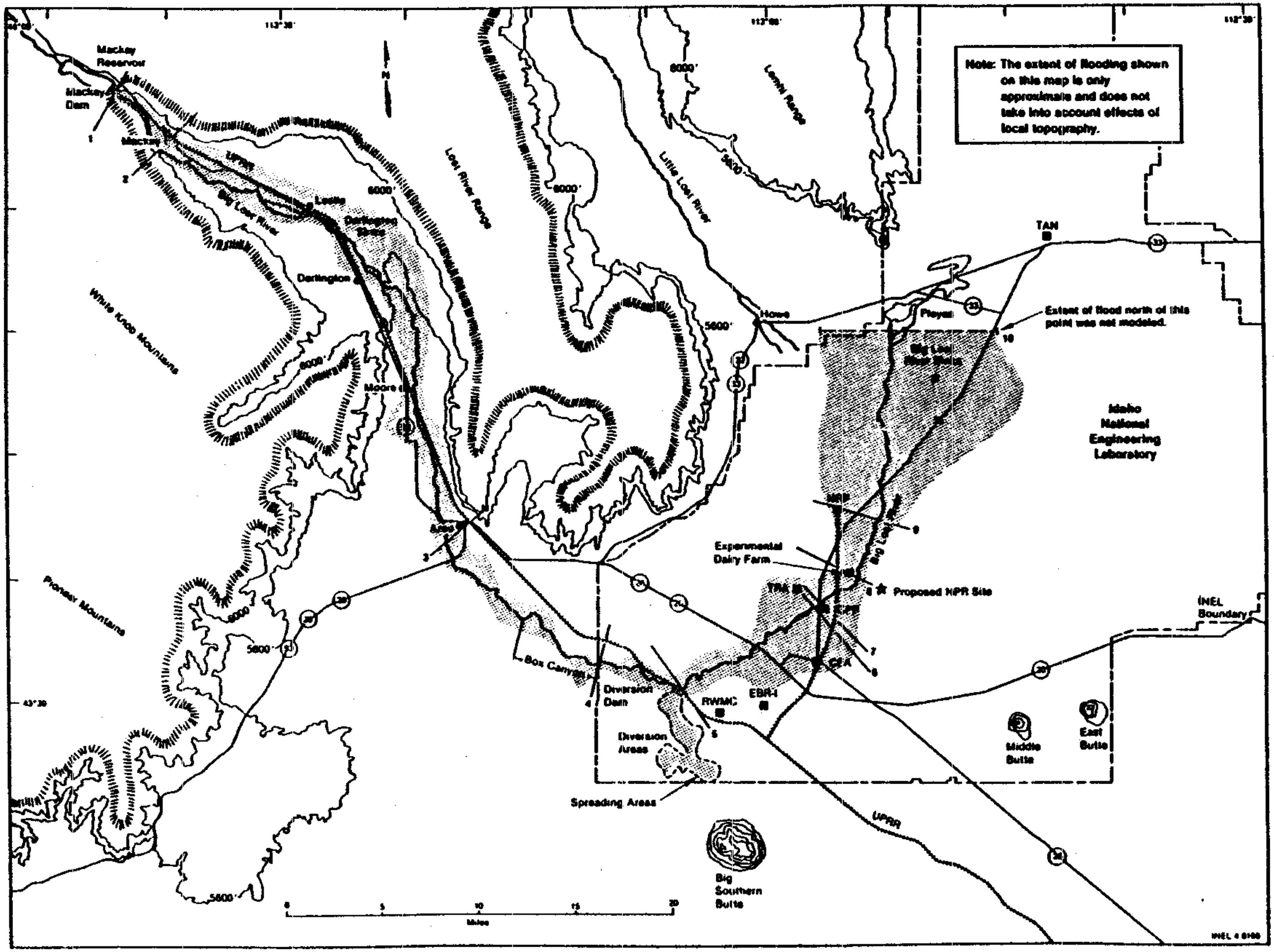

Figure 3.5. Base case inundation map.

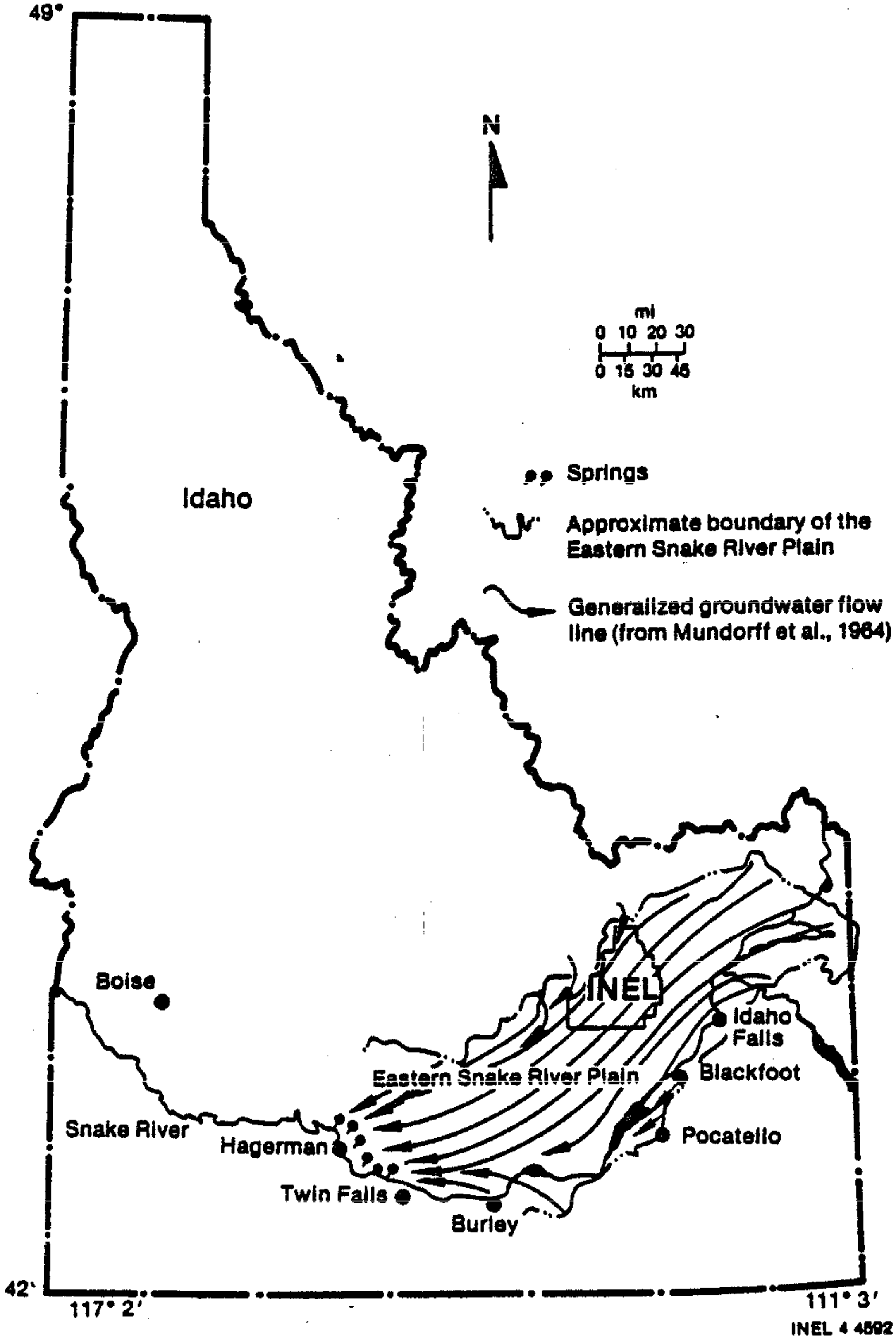

Figure 3.6. Location of generalized groundwater flow lines hypothesized for the Snake River Plain aquifer.

ranges from 3×10^4 to 1.8×10^7 gallons per day per ft (gpd/ft). Storage coefficients range from 0.01 to 0.06[x]. Generalized altitude contours[y] are shown in Figure 3.7. Depth to the water table from land surface ranges from about 60 m (200 ft) in the northeast corner of the INEL to 300 m (1000 ft) in the southeast corner.

In 1983, the entire INEL water supply was provided by 24 production wells which tapped the Snake River Plain aquifer. The wells pumped a total of 7.9×10^6 m^3 (1.8×10^9 gallons) for the year. Over half of the volume pumped was returned to the surface or subsurface by waste water disposal operations. (Subsurface injection of wastewater has since been ceased.) An additional unknown amount also returns underground by infiltration from lawn irrigation and other water uses. A significant amount (about one third) of the pumped water is consumed by evaporation and transpiration to the atmosphere, principally from reactor cooling towers. It has been calculated that roughly 2,000 cfs flows beneath the INEL Site at its widest point which is equivalent to 1.8×10^9 m^3/yr. Therefore, in 1983 the INEL pumped less than 1% of the INEL underflow and less than 0.1% of the volume that surfaces as springs down gradient from the Site.

Recharge to the Snake River Plain aquifer is primarily in the form of infiltration from the rivers and streams draining the areas to the north, northwest, and northeast of the Eastern Snake River Plain. Significant recharge from increased flows in the Big Lost River has caused a regional rise in the groundwater table over much of the INEL. Water levels in some wells rise as much as 2 m (6 ft) within a few months following very high flows in the river.

Perched water tables occur beneath the plain in areas where water infiltrating the ground surface is delayed by layers of fine-grained sediments with low permeability. Perched water occurs below the Big Lost River, the waste-seepage ponds at the Test Reactor Area (TRA), and other areas of the INEL.

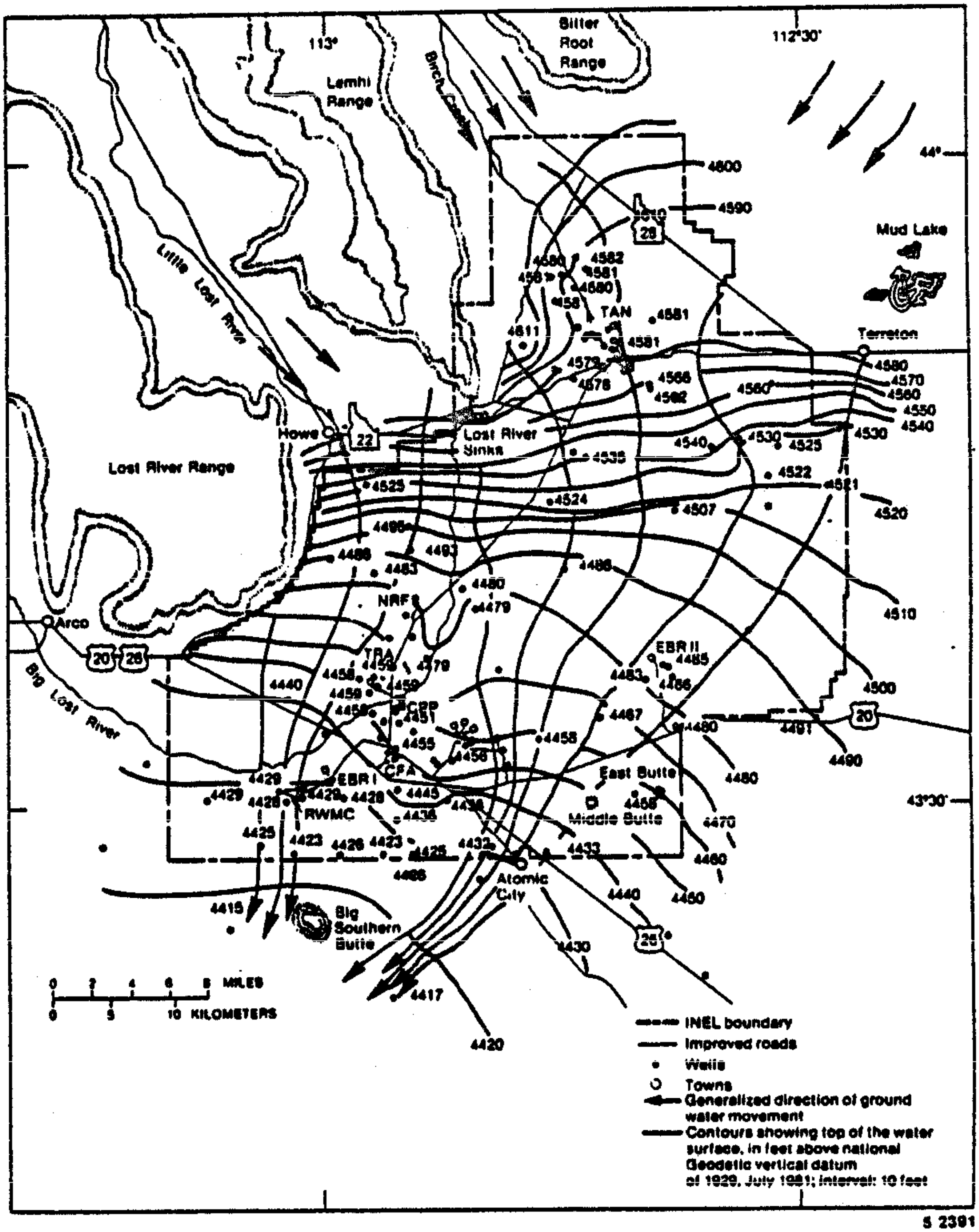

Figure 3.7. Generalized altitude contours on the regional water table, and inferred directions of groundwater flow, INEL and vicinity (July 1981).

3.4 Air and Water Quality

3.4.1 Air Quality

Air pollutant emissions which result from industrial operations at INEL or from surrounding communities are small. In addition, atmospheric dispersion at INEL is not constrained by topography, and the site has no significant air stagration problems. The air quality at INEL is very good; data available indicates the air quality is well within Primary and Secondary Standards as established by EPA.

Since air quality is within established guidelines, no parts of the INEL have been designated as non-attainment areas by the State of Idaho. The closest such area to the INEL is Pocatello, about 50 miles to the south. The area of Pocatello has been identified as a non-attainment area for not meeting the total suspended particulate standards. However, this is a localized condition and does not impact air quality at the INEL.

3.4.2 Water Quality

The chemical quality of groundwater of the INEL reflects the different sources of recharge and the minerals dissolved from rocks with which it comes in contact. Chemical analyses of surface waters from the Big Lost River, Little Lost River, and Birch Creek are given in Table 3.3. These rivers flow through fractured carbonate rocks consisting of relatively soluble calcite and dolomite. As a result, surface waters from this region contain calcium and magnesium bicarbonate. Small quantities of sodium, potassium, and silica are also present.

Water from the Snake River Plain aquifer containing a relatively larger percentage of sodium and potassium underlies the eastern half of the INEL. Some of this water originates in the mountains to the north and northeast. The mountainous recharge areas are underlain by silicic volcanic rocks which are much higher in sodium, potassium, and silica than are the rocks to the west.

TABLE 3.3. CHEMICAL ANALYSES OF SURFACE WATER AND GROUNDWATER FROM THE REGION NORTH, NORTHEAST, AND NORTHWEST OF THE INEL[a]

Analyses	Big Lost River Near Moore, ID 08/27/63 (1020 h)	Little Lost River Near Howe, ID 09/03/63 (1020 h)	Birch Creek South of Blue Dome 09/03/63 (1145 h)	Medicine Lodge Creek Near Medicine Lodge 09/03/63 (1305 h)	Well 2N26E 36aal Near Arco, ID 08/30/57 (Depth: 57.9 m)
Silica	12.0	12.0	8.8	18.0	24.0
Calcium	48.0	39.0	39.0	64.0	67.0
Magnesium	11.0	15.0	14.0	17.0	18.0
Sodium	6.9	6.7	5.0	8.6	9.0
Potassium	1.4	1.2	1.0	2.5	1.8
Bicarbonate	192.0	177.0	164.0	233.0	274.0
Carbonate	0.0	0.0	0.0	0.0	0.0
Sulfate	18.0	16.0	25.0	48.0	24.0
Chloride	3.5	8.8	4.5	6.0	7.5
Fluoride	1.9	0.2	0.2	0.1	0.3
Nitrate	0.5	0.6	0.6	0.1	1.7
Specific conductance (μmhos at 25°C)	333.0	323.0	309.0	453.0	489.0
pH (pH units)	7.7	7.7	8.0	7.8	7.6
Residue on evaporation at 180°C	191.0	192.0	186.0	284.0	289.0
Temperature °C	--	12.2	14.4	12.8	13.0

a. Analyses in mg/L, except as indicated.

The waters from the Snake River Plain aquifer on the INEL are relatively low in the sum of dissolved constituents (an average of slightly more than 200 mg/L). The low mineralization reflects the moderate-to-abundant precipitation in the mountainous source areas, the absence of extensive deposits containing soluble minerals, and the low solubility of the basalt that forms the principal aquifer system. The water in the aquifer is of high quality and with modest treatment can be made suitable for most uses. Table 3.4 provides the high, low, and average chemical analysis values for groundwater samples taken at various locations in the area of the INEL. The data are based upon single-sample results from 35 different wells. The individual samplings occurred at various dates from 1951 to 1968.

The Snake River Plain aquifer is the only source of water used at the INEL. Water pumping and the effect on water levels in the aquifer are closely monitored by the U.S. Geological Survey. Pumping has very limited and localized effect on annual water-level changes in the aquifer in the vicinity of the INEL because the amount pumped is a small portion of the total storage and recharge.

3.5 Environmentally Sensitive Conditions

3.5.1 Protection of Groundwater Quality

The single most sensitive environmental characteristic associated with hazardous waste disposal practices at the INEL is probably the Snake River Plain aquifer. As described in Section 3.3.2, this vast aquifer underlies the entire INEL and provides all of the industrial, irrigation and culinary water for the Site. The down gradient portion of the aquifer also provides the primary source of water for the arid plain area stretching southwest from the Site to the area around Hagerman where the aquifer surfaces in springs. At that point the surfacing water contributes significantly to the flow in the Snake River. The aquifer is considered a valuable natural resource of the State and its contamination could have far-reaching impacts.

The U.S. Geological Survey routinely monitors the Snake River Plain aquifer around the INEL and has documented the migration of radionuclide contamination caused by operations there. A limited number of nonradioactive parameters are considered in the routine sampling; their migration has also been well documented. Concentrations of tritium, which is not diminished by sorption on earth minerals, have been detected in the aquifer as far as 14.5 km (9 mi) down gradient from their point of disposal; a migration that may have started as early as 1952. Other radionuclides have migrated shorter distances. Some chemical parameters that have been measured, such as sodium, chloride, sulfate and nitrate, have also formed waste plumes. However, none of these wastes can be detected more than about 8 km (5 mi) from the disposal site. Radionuclide plume size and concentrations are controlled by aquifer flow conditions, the quantity discharged, radioactive decay, sorption, dilution by dispersion, and perhaps other chemical reactions. Chemical parameters are subject to the same processes except for radioactive decay.

Several public action groups have already expressed concern over maintaining the quality of the Snake River Plain aquifer and will probably continue to do so. INEL actions that may impact the aquifer either

TABLE 3.4. CHEMICAL ANALYSES OF THE SNAKE RIVER AQUIFER IN THE VICINITY OF THE INEL

Analyses	Results (mg/L unless otherwise stated)		
	Average	High	Low
Dissolved Solids			
Ca	39.6	93.0	26.0
Mg	15.6	43.5	3.9
Na	13.2	42.0	6.3
K	3.0	6.9	1.2
HCO_3	162.0	218.0	81.0
CO_3	0.5	9.8	0.0
SO_4	24.9	57.0	9.1
Cℓ	19.7	160.0	6.5
NO_3	2.9	29.0	0.5
F	0.3	0.9	0.03
SiO_3	25.8	39.0	15.0
Fe	0.08	0.52	0.0
Hardness as $CaCO_3$			
Total	161.8	368.0	94.0
Noncarbonate	26.7	215.0	0.0
pH (no units)	7.9	8.4	7.6
Specific conductance (μmhos at 25°C)	356.0	963.0	225.0
Residue on evaporation at 180°C	226.0	583.0	153.0
Temperature when collected (°C)	12.8	16.7	10.0

negatively or positively, will be of concern to these groups. Protection of the groundwater quality is not only an environmentally sensitive issue, but will likely become a very politically sensitive one.

3.5.2 Seismology

Prior to 1970 the INEL was classified in Seismic Zone 2 of the Uniform Building Code of the International Conference of Building Officials. In 1970 the classification was changed to the higher-risk Zone 3, which imposed more stringent design criteria on facilities constructed thereafter. Data cataloged by the National Geophysical and Solar Terrestrial Data Center of the National Oceanic and Atmospheric Administration (NOAA) indicate that regional earthquakes are historically centered around, but do not occur on, the Eastern Snake River Plain. However, ground motion produced by earthquakes in the mountains can be transmitted onto the plain.

The largest historical earthquake event in the Idaho seismic zone, which lies north and northwest of the INEL, occurred on October 28, 1983, and had a Richter magnitude of 7.3. The epicenter for this event was located along the western flank of Borah Peak in the Lost River Range approximately 64 km (40 mi) northwest of Arco. Another major earthquake occurred August 17, 1959 at Hebgen Lake, approximately 160.9 km (100 mi) from the INEL and had a Richter magnitude of 7.1. Shocks from both earthquakes were felt at the INEL, but neither caused structural or safety related damage.

The data compiled by NOAA and other studies accomplished since 1970 appear to suggest that the plain is rather aseismic. Although the plain is certainly not free of seismic risk, many had felt all factors pointed toward there being less risk than the Zone 3 classification would imply. Therefore, in October 1981 the INEL and surrounding area were again reclassified, this time back to a Seismic Zone 2.

3.5.3 Flooding Potential

The potential for flooding problems on the INEL was discussed in Section 3.3.1. In 1962 and again in 1969 rapid snow melt and heavy precipitation caused flooding of the burial ground at the Radioactive Waste Management Complex (RWMC). Since those events, significant work has been done on the Big Lost River drainage to prevent flooding problems, but the possibility of diversion structure or upstream dam failure, although slight, does exist. Flooding in the northern area of the INEL from Birch Creek is also a potential problem. Control measures have also been implemented in the northern area, but with much of the INEL located in a closed drainage basin, the possibility of surface water accumulations in some areas of the Site is still present.

3.5.4 Endangered Species

Two species of milk vetch currently under Federal review for endangered or threatened status were found on the INEL (*Astragalus ceramicus* var. *apus* and *Astragalus purshii* var., *ophigenes*). These species were located during a 1981-1982 survey of rare plants on the INEL conducted by the University of Idaho. Three taxa on the Idaho State Watch List are also found on the INEL, and four other species were found and recommended for the list. Taxa on the Idaho State Watch List are considered rare and of special interest, but their populations are not in jeopardy and they may be common elsewhere.

The bald eagle and the American peregrine falcon are the only species observed on the INEL that are classified as endangered or threatened wildlife. Several bald eagles (endangered status) usually winter on or near the INEL. The peregrine falcon (endangered status) has been observed infrequently on the northern portion of the INEL. Several species of wildlife observed on the INEL are of special concern to the Idaho Department of Fish and Game and the Bureau of Land Management. These species include the ferruginous hawk, merlin, gyrfalcon, osprey, burrowing owl, white-faced ibis, long-billed curlew, and bobcat. However, only the ferruginous hawk, burrowing owl, long-billed curlew and bobcat occur regularly on the INEL.

3.6 Biological Pathways

The biological pathway of primary concern at the INEL is through the water of the aquifer underlying the Site. This is of primary concern because of the aquifer's extent, its wide usage on site and off site (down gradient), and its being the primary means of off-site migration of contaminants resulting from past disposal practices. This water is consumed by both humans and animals (livestock) and is utilized as an irrigation source, all potential biological pathways for water contaminants. On the other hand, naturally occurring surface waters on site have no significant downstream usage, and actually terminate on site where they either evaporate or become part of the aquifer by infiltration.

Probably the next most significant biological pathway is a result of process waters being discharged to evaporation/seepage ponds which are then used by animals. This pathway is extended to humans when game animals use these contaminated surface waters and subsequently move off site where they are harvested and consumed by hunters. The potential transport of radioactivity to individuals via this pathway has been studied for many years. Although not covered specifically in these studies, it can be assumed that some of the hazardous chemical constituents that might be found in these waters will also be available for biological uptake. Studies on radionuclide transport suggest that ingestion of meat from waterfowl that have resided on contaminated ponds presents the most important pathway through game animals. Transport by morning doves, sage grouse and antelope residing for some time on site and eventually being killed and consumed has also been studied.

Air transport and direct vegetation uptake of contaminants also present potential biological pathways. Air dispersion of dry pond or spill sediments, subsurface contaminants brought up by burrowing animals, and other such materials, as well as their uptake by vegetation, are possible. The fact that the INEL is remote and has no permanent population and no agricultural usage appears to make the significance of these potential pathways minimal.

4. FINDINGS

Past activities involving both waste generation and disposal were reviewed to assess the hazardous waste operations that generated inactive disposal sites at the INEL. This section contains the findings of the activity reviews by individual activity. For convenience, the reviews are grouped by general locations within the INEL. These general locations and the sections in which they are discussed are as follows:

1. Test Reactor Area (TRA)--Section 4.1

2. Test Area North (TAN)/Technical Support Facility (TSF)--Section 4.2

3. TAN/Loss-of-Fluid Test (LOFT) Facility--Section 4.3

4. TAN/Initial Engine Test (IET) Facility--Section 4.4

5. TAN/Water Reactor Research Test Facility (WRRTF)--Section 4.5

6. Auxiliary Reactor Area (ARA)--Section 4.6

7. Power Burst Facility (PBF) Area/SPERT--Section 4.7

8. Experimental Organic Cooled Reactor (EOCR) Area--Section 4.8

9. Organic Moderated Reactor Experiment (OMRE)--Section 4.9

10. Boiling Water Reactor (BORAX) Area--Section 4.10

11. Experimental Breeder Reactor-1 (EBR-1)--Section 4.11

12. Zero Power Reactor (ZPR)--Section 4.12

13. Liquid Corrosive Chemical Disposal Area (LCCDA)--Section 4.13

14. Munitions/Ordnance Areas--Section 4.14

15. Central Facilities Area (CFA)--Section 4.15

16. Radioactive Waste Management Complex (RWMC)--Section 4.16

File information, past reports, interviews, and site visits provided identification of hazardous material usage and hazardous waste generation from operations within the above locations . A master list of active shops by building was generated and is included in Appendix B, Table B.1. This master list includes any lab or shop operation where hazardous materials or wastes may have been involved. If further investigation determined that hazardous materials were not used and hazardous wastes were not produced at a particular operation, then it is not addressed further in the main text.

Since 1976 records have been kept on incidents occurring at EG&G (and the previous site contractor) facilities which have disrupted operations or presented unusual problems. The records, Unusual Occurrence Reports (UORs), are maintained by EG&G Health and Safety Division and include documentation of most spills that have occurred since 1976. UORs and interviews were the major sources of spill information used in preparation of this document.

Also included in this section is an identification of the individual disposal sites at the general locations considered. All sites are documented and, for any appearing to have a potential for migration, a hazardous assessment score using the Hazard Ranking System (HRS) is provided in the Section 5 conclusions.

4.1 TRA Past Activity Review

4.1.1 TRA Description

The Test Reactor Area (TRA) of the INEL provides facilities for studying the performance of materials and equipment under high neutron flux conditions. While originally intended primarily for furthering the reactor development programs of DOE and its predecessors, the irradiation facilities have occasionally been made available to educational, research, industrial, and commercial users, as well as to other federal agencies. This irradiation testing can ascertain in weeks or months what might take years to discover in reactors designed for purposes other than testing.

The TRA is located in the south central part of the INEL, as shown in Figure 3.3. It can be divided functionally into a reactor area and a utility area. The reactor area contains the inactive Materials Test Reactor (MTR) and Engineering Test Reactor (ETR) and the still operating Advanced Test Reactor (ATR). In addition to the three primary reactors, four low-power reactors, the Advanced Test Reactor Critical (ATRC) facility, two Advanced Radioactivity Measurement Facilities (ARMFs), and the inactive Engineering Test Reactor Critical (ETRC) facility, are located in the reactor area. This area also includes the offices, warehouses, and maintenance facilities that support the reactor facilities. The utility area contains nonnuclear support equipment and facilities. Figure 4.1.1 is a plot plan of TRA.

4.1.2 TRA Wastes Generated by Specific Activity

4.1.2.1 TRA Reactor/Utility Operations (Shops, Labs and Processes). Further screening of the areas identified in Table B.1 of Appendix B produced a list of shops, labs, and processes at TRA which were considered to pose a potential for contamination. Table 4.1.1 provides the refined list of facilities and also provides the hazardous waste constituents involved, the timeframes in which the hazardous wastes were produced, and

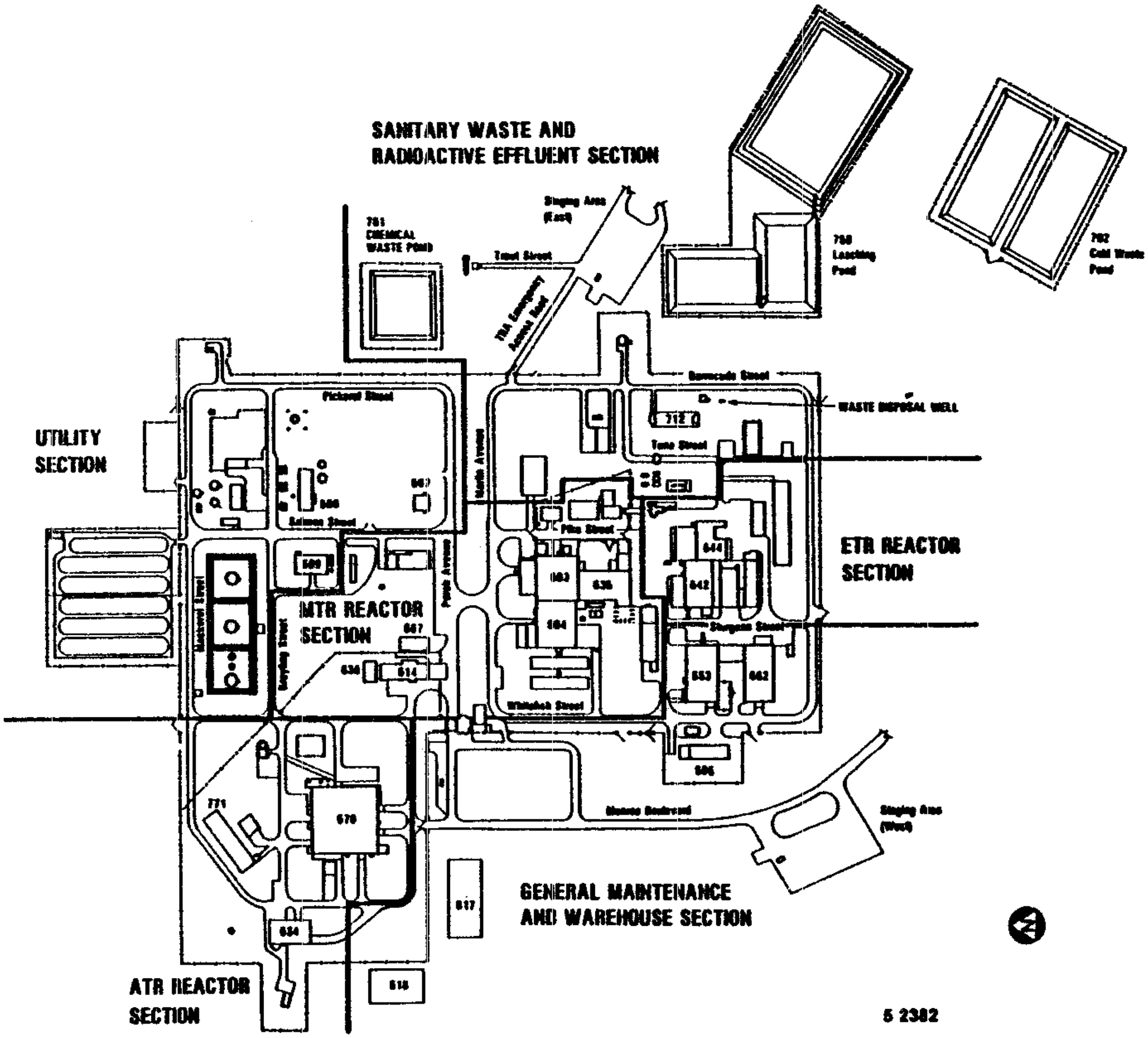

Figure 4.1.1 Test Reactor Area plot plan.

TABLE 4.1.1. TEST REACTOR AREA FACILITIES WASTE GENERATION

Shop Location	Function	Waste Stream	Timeframe	Estimated Quantities (If Known)	Treatment/Storage/Disposal
TRA-606	Paint shop	Waste thinners and solvents	1957-1982	420 l/yr	Open ditch east of building
		Waste thinners and solvents	1982-present	420 l/yr	Drummed and shipped off site as HW
		Empty and partially empty cans			
		1-gal cans (lead base primers, latex and epoxy)	1957-present	20 cans/mo.	CFA landfill
		5-gal cans (lacquer)	1957-present	2 cans/mo.	
TRA-608	Demineralization plant	Regeneration discharge from ion exchangers			
		Sodium hydroxide (NaOH)	1952-1961	6×10^5 kg	Warm-waste leach pond (TRA-758)
		Sodium hydroxide	1962-1984	1.8×10^6 kg	Chemical waste pond (TRA-701)
		Sodium hydroxide	1984-present		Neutralized prior to discharge to TRA-701
		Sulfuric acid	1952-1961	3.3×10^6 kg	Warm-waste leach pond
		Sulfuric acid	1962-1984	9.9×10^6 kg	Chemical waste pond
		Sulfuric acid	1984-present		Neutralized prior to discharge to TRA-701
		Regeneration discharge from water softener			
		Salt	1952-1961	4.8×10^5 kg	Warm-waste leach pond (TRA-758)
		Salt	1962-1971	4.4×10^5 kg	Chemical waste pond (TRA-701)
TRA-609	Steam plant	Blowdown water--makeup water treated with Ferrosperse, sulfite and phosphate	1952-1963	5.0×10^5 l	Warm-waste leach pond (TRA-758)
			1964-1982	7.9×10^5 l	TRA injection well
			1983-present	110 l/day	Cold-waste pond (TRA-702)
TRA-632	Hot cells	Degreasing waste--mixed radioactive	1952-present		Idaho Chemical Processing Plant (ICPP) for processing through the Process Equipment Waste (PEW) evaporator and calciner system
		Acetone		20 l/yr	
		Methylene Chloride		210 l/yr	
		Ethyl Alcohol		40 l/yr	

TABLE 4.1.1. (continued)

Shop Location	Function	Waste Stream	Timeframe	Estimated Quantities (If Known)	Treatment/Storage/Disposal
TRA-632	Hot Cells (continued)	Methal-etching waste--mixed radioactive	1952-Present		ICPP-PEW and calciner
		Nitric Acid		10 L/yr	
		Hydrochloric Acid		10 L/yr	
		Hydrofluoric Acid		1 L/yr	
TRA-642	ETR bypass demineralizer	Spent cation resins--no regeneration	1957-1982		RWMC
		Anion resin regeneration (50% NaOH solution)	1957-1973	10,000 L/yr	Warm-waste leach pond
			1974-1981	1,000 L/yr	Warm-waste leach pond
TRA-604/661	TRA chem labs	Ignitable wastes	1952-1984	3,250 kg	Warm-waste leach pond
			1952-1984	1,250 kg	ICPP-PEW and calciner
		Reactive wastes	1952-1984	45 kg	Warm-waste leach pond
			1952-1984	15 kg	ICPP-PEW and calciner
		Corrosive wastes	1952-1984	2,150 kg	Warm-waste leach pond
			1952-1984	850 kg	ICPP-PEW and calciner
		EP toxic wastes	1952-1984	45 kg	Warm-waste leach pond
			1952-1984	15 kg	ICPP-PEW and calciner
		All hazardous lab wastes	1984-Present		Drummed and shipped off site as HW
TRA-666	Hydraulic test facility	Wastewater--lightly contaminated with chromium (2.6 ppb)	1964-1982	0.6 kg	TRA injection well
			1982-1983	<0.1 kg	Cold-waste pond (TRA-702)
TRA-670	ATR bypass demineralizer	Spent cation resins--no regeneration	1969-Present		RWMC
		Spent anion resins--no regeneration	1969-Present		RWMC
TRA-751	MTR & ETR cooling towers (wastes actually produced at MTR & ETR)	Cooling water blowdown--Prior to 1972 chromates were added as part of the corrosion control treatment. Quantities listed are for chromium (Cr^{+6})	1952-1964	12,600 kg	Warm-waste leach pond (TRA-758)
			1964-1972	13,400 kg	Injection well

the disposal methods. Several facilities on the Appendix E master list have been deleted from Table 4.1.1 due to insignificant waste quantities. The facilities in Table 4.1.1 are further discussed in the following paragraphs.

The paint shop at TRA-606 generates approximately 420 liters per year of a mixture of waste thinners, solvents and paint strippers. A typical sample of the mixture might contain 50% mineral spirits, 20% xylene, 20% toluene, 5% acetone, and 5% water. Prior to 1983, this waste was dumped into a storm drainage runoff ditch located just east of the shop. Since about the beginning of 1983 these wastes have been poured into 55-gal drums and shipped off site as hazardous wastes. The paint shop also generates a considerable number of empty cans and dirty rags that are thrown into a dumpster and eventually find their way to the sanitary landfill at CFA. Approximately 20 1-gal cans (primarily from latex paints, but some from epoxies and lead-base primers) and two 5-gal cans (usually from lacquer) are thrown in the dumpster each month. It is likely that some of these cans are not totally empty; estimated numbers or content quantities are, however, unavailable.

The demineralization plant (TRA-608) has been providing demineralized water for reactor operations since 1952. Water is treated by ion exchange, which means the ion-exchange columns must be periodically regenerated. Sulfuric acid and sodium hydroxide are used to regenerate the cation and anion units. From 1952 through 1961 these regenerants of alternating high and low pH were discharged to the warm-waste leach pond (TRA-758). From 1962 to about August 1984, the regenerant discharge was rerouted to a chemical waste pond (TRA-701) specifically constructed for this waste.

Over the last 13 years this discharge has averaged about 100 million liters per year. Both acidic and basic solutions have been discharged to the same location, but at different intervals. As shown in Table 4.1.1, the acidic discharge has been significantly greater than the basic. Therefore, prior to August 1984, neutralization in ponds may have occurred but probably not to an extent that would always prohibit wastes with hazardous characteristics (corrosive) from being released to the environment. Since August 1984, regenerants have been routed through an existing brine tank, where they are held until they can be neutralized before discharge to the chemical waste pond.

The demineralization plant also houses two zeolite water softeners which have been used in the past but are not currently in use. Regeneration of these units produced a waste salt solution. As with the discharge from the ion-exchange regeneration, this salt solution was sent to the warm-waste leach pond (TRA-758) from 1952 to 1961 and then rerouted to the chemical waste pond (TRA-701) in 1962. These water softeners have not been used since 1971, but when in operation they used about 3,600 kg of salt per month.

The hot cells (TRA-632) are designed for the remote examination of nuclear fuels and radioactive materials. These examinations often include degreasing/cleaning operations and metal etching, using small quantities of solvents and acids respectively. The figures in Table 4.1.1 represent estimated quantities of waste of the specific chemicals involved. These quantities are based on chemical usage and do not include any consumption or evaporation which may be significant, particularly in the case of solvents.

The waste products from the hot cells (which are byproduct wastes because they are contaminated with special nuclear material) are washed to drains that lead to hot-waste tanks serving the hot cells. These tanks are periodically pumped and the contents taken to the Idaho Chemical Processing Plant (ICPP) for treatment. Some of the hot-cell wastewater has, at short intervals in the past, been discharged to the warm-waste leach pond because of low radionuclide activity. However, it was found that this practice caused some unwanted radionuclide species to accumulate in the pond sediments, so the practice was discontinued. Because of the short period of time and small quantities of hazardous contaminants involved, it is assumed that wastewater from the hot cells has been an insignificant source of hazardous waste contamination for the warm-waste leach pond.

The primary cooling water loop of the ETR used a bypass demineralizer system (located in TRA-642) to maintain water quality. The system consists of two cation and two anion resin tanks. The cation resins have a relatively long life, and a disposable-type resin was used. Depleted cation resin beds were flushed to a shielded container, drained of water (to warm-waste collection system), and shipped to the RWMC for disposal. The anion resin beds were periodically regenerated with a sodium hydroxide solution. An anion bed was regenerated approximately every week to ten days with about 50 to 60 gallons of a 50% sodium hydroxide solution. This schedule held from 1957 until about 1974, when ETR operations were curtailed. From 1974 to its August 1981 shutdown, the anion beds were regenerated only a few times each year. In fact, from November 1980 to August 1981 it is estimated that only a single anion bed was regenerated. The regenerant solutions were drained to the TRA retention basin and then to the warm-waste leach pond. The radioactivity was always low enough after a minor holding period to allow discharge to the pond. ATR has a similar bypass demineralizer system on its primary water loop, but in this case, both cation and anion resin beds are replaced after they are depleted; no regeneration is accomplished.

Prior to mid-1984, the primary TRA chemistry labs (TRA-604 and TRA-661) routinely poured waste or used chemicals and reagents down laboratory drains. These drains are connected to the TRA warm-waste collection system which eventually either goes to the warm-waste leach pond or, if radionuclide activity is too high, is shipped to the ICPP for treatment through the Process Equipment Waste (PEW) evaporator and the calciner system. The breakdown shown in Table 4.1.1 shows an assumed 72/28 percent split between wastes going to the pond and those going to the ICPP. This split was obtained from 1983 records and is representative of what had happened in past years. Since mid-1984, these laboratory wastes have been placed in lab packs for ultimate disposal/treatment off site as hazardous waste. The waste stream shown in Table 4.1.1 for this source actually represents basic groupings of numerous chemicals and solutions. Specific chemicals found in the waste stream from these labs were identified in a waste characterization study done in late 1984. A majority of the laboratory waste was considered to be byproduct because it became radioactive through contact with special nuclear material. It is quite likely that because of the large volumes of wastewater going to the warm waste pond and the small quantities of lab waste involved, these wastes were not detectable by the time they reached the pond.

The hydraulic test facility (TRA-666) performed mock-up testing of reactor core components using clean demineralized water. From 1964 to August 1983, when it was last used, the facility produced about 300,000 gal/mo of what was considered nonhazardous wastewater. This wastewater was discharged to the TRA injection well until March 1982, at which time it was rerouted to the newly constructed cold-waste pond (TRA-702). One reason the facility stopped testing in 1983 was the buildup of metal contamination in the water loop due to corrosion and scouring. Among the problem metals was chromium, which is considered hazardous at high enough concentrations. However, for the needs of the hydraulic test facility, the metal levels of concern were all in the parts-per-billion range. Chromium averaged only 2.5 ppb over six samples, which was still below the allowable level for drinking water. Although Table 4.1.1 shows the total amount of chromium that would have been discharged at 300,000 gal/mo from 1964 to 1983, the hydraulic test facility is considered an insignificant source of contamination.

Past practices followed in the disposal of cooling tower blowdown added chemicals to the make-up water to prevent corrosion of the cooling system. The secondary cooling water systems of the TRA reactors remove heat from their corresponding primary water loops through heat exchangers. Secondary cooling waters are then passed through cooling towers to dissipate the heat gained. Some of the water in the secondary loop evaporates, while some is lost to blowdown.

Prior to 1972, secondary cooling water at MTR and ETR was pretreated with corrosion-preventing solutions which contained chromates. Hexavalent chromium concentrations were maintained at about 11 to 14 ppm. The amount of chromium lost from the system via blowdown is recorded in the Industrial Waste Management Information System (IWMIS). However, the first IWMIS data is for 1971, and the only records for chromium discharge are for 1971 and the first eight months of 1972, at which time the chromate-based corrosion preventative was changed to a phosphate-based solution. During the 20 months of record, 175 megawatts (MW) of power were produced by ETR. The pre-1971 data in Table 4.1.1 were obtained by assuming that the average chromium discharge per MW during those 20 months could be extrapolated to past operations. (The assumption is that the amount of blowdown is directly proportional to the power produced.) This assumption was applied to two periods: (1) When MTR and ETR were operating simultaneously (215 MW), and (2) when MTR was the only operating reactor (30 and later 40 MW). From 1952 through October 1964, cooling tower blowdown was discharged to the warm-waste leach pond; from November 1964 through March 1982, it was discharged to the TRA underground injection well; and since then it has been discharged to a new cold-waste pond (TRA-702). Table 4.1.1 provides no post-1972 data since the blowdown discharges have had no hazardous constituents since that time. ATR did start up in 1967 but only used phosphate-based corrosion preventatives in its secondary water. For that reason, ATR blowdown water has not been included either in this discussion or in Table 4.1.1.

Evaporated water from the cooling towers may also be considered an atmospheric contaminant since some hardness ions and chemical additives (such as the chromium in corrosion preventatives) are released to the atmosphere. In high winds, as much as 100 gpm of water with additives can be blown from a TRA cooling tower and deposited on the ground downwind. At 175 MW, and during normal conditions, ETR was also responsible for cooling tower evaporation of about 1,000 gpm. Loss of chemicals to the atmosphere in carryover and by evaporation has not been measured or estimated since they were dispersed over an unconfined area. Also, it can be assumed that a significant portion of the dissolved solids from the evaporated water remains in the cooling tower where it may adhere to baffles, return to the secondary water system, or contribute to the blowdown.

Historically, several TRA shops, particularly the steam plant (TRA-609) and the craft shops (TRA-625 and TRA-653), have occasionally used small amounts of solvent to clean or degrease tools and work materials. The solvent is generally applied by hand with rags, which are then thrown in with other nonradioactive refuse. (General refuse ultimately goes to the Central Facilities Area landfill.) The solvent appearing to be most available and most often used for this type of operation is methylene chloride. This waste stream is not included in Table 4.1.1 because it is assumed that the small, irregularly generated quantities of solvent evaporate before disposal takes place.

4.1.2.2 TRA Fuels/Petroleum Management. Bulk fuel usage at TRA is basically limited to No. 5 Fuel Oil (which is burned in the boilers) and diesel fuel, used in standby power generators. In both instances, the product is delivered to TRA in tank trucks where it is pumped to aboveground storage tanks via the fuel oil pumphouse (TRA-627). From stains on the ground around the piping manifold at the fuel oil pumphouse it appears that there is minor spillage during the filling operations. The large tanks feed several smaller day-tanks located at the place of consumption. Two underground gasoline tanks are also serviced by tank truck. Table 4.1.2 provides an inventory of the fuel/petroleum storage tanks at TRA.

New stock of oils, lubricants, and small amounts of solvents that are brought into TRA in 55-gal drums are often stored on an open loading dock (TRA-722) located between the boiler plant (TRA-609) and the cafeteria (TRA-616). Use of this dock for combustible liquid drum storage should soon be replaced by using space in the newly constructed Hazardous Chemical Storage Facility (TRA-640).

4.1.2. TRA--FUEL/PETROLEUM STORAGE TANKS

Location	Oil Type	Maximum Capacity (g)	Above (A), Underground (U), Outside (O), Inside (I)	Level Check	IMMS #	Responsibility	Comments
TRA-605	Gasoline	--	U, O	--	--	--	Abandoned, south side of building
TRA-606	Unleaded gasoline	3,500	U, I	Aboveground gauge	01SSW403	Site Services	Protective coating
TRA-610	Gasoline	--	A, O	--	--	--	Abandoned; east side of building
TRA-616	Gasoline	--	U, O	--	--	--	Abandoned; filled with sand and capped
TRA-619	Gasoline	500	U, I	Aboveground gauge	--	TRA facility	--
TRA-619	Diesel No. 1	300	A, I	Aboveground gauge	--	TRA facility	Curbing
TRA-620	Diesel blend	5,000	U, O	Dipstick	01SSW411	Transportation	--
TRA-633	Diesel No. 1	750	A, I	Aboveground gauge	--	TRA facility	Curbing
TRA-643	Diesel	--	A, I	--	--	--	Abandoned
TRA-727A	No. 5 fuel oil	221,456	A, O	Gauge on outside of tank	01BFW459	TRA facility	--
TRA-727B	No. 5 fuel oil	221,456	A, O	Gauge on outside of tank	01BFW460	TRA facility	--
TRA-727C	Diesel No. 2	29,957	A, O	Gauge on outside of tank	01BFW450	TRA facility	--
TRA-727D	Diesel No. 2	91,896	A, O	Gauge on outside of tank	01BFW450	TRA facility	--
TRA-775	Diesel No. 2	34,940	A, O	Gauge on outside of tank	01BFW450	TRA facility	--

4.1.2.3 Spills within the TRA. Review of Unusual Occurrence Reports (UORs), personnel interviews, and site observations provided information on the spills identified in this section.

In 1976 radioactive ion-exchange resins were spilled when depleted resins were being flushed from ETR to a tank truck. The resins were cleaned up and taken to the Radioactive Waste Management Complex (RWMC) for disposal.

In February of 1977, one of the batteries used for standby power fell off a cart and ruptured, leaking the sulfuric acid electrolyte onto the floor of the ETR facility. The acid was washed down the nearest floor drain which led to the warm-waste leach pond (TRA-758).

In September of 1978, a leaking cask was moved from ATR to the TRA hot cells (TRA-632). Radioactive water leaked over a narrow strip of asphalt on the roads between the buildings. The strip of contaminated roadway was dug up and taken to the RWMC for disposal.

A sulfuric acid spill occurred in March of 1980 during construction work which involved an acid supply line. The line was isolated so the amount of acid spilled was minimized, but heat from an adjacent steam pipe caused pressure buildup in the pipe so that it spurted when a valve was opened. The entire area involved in the spill was hosed down with water.

In June 1981, an incident occurred in which a minor amount of radioactive primary cooling water found its way to the TRA disposal well (normally reserved for nonradioactive wastewater). However, the radioactivity of the water discharged to the well was below the activity level allowed for uncontrolled area releases. The source of the discharge was eliminated but no attempt was made to retrieve the lost water.

In the spring of 1983, approximately 100 gal of sulfuric acid were spilled at the ATR Secondary Pumphouse (TRA-671). The acid spread over a fairly large area of the hardpan soil on the southeast side of the building. The concentrated acid was at least partially neutralized by the addition of sodium bicarbonate. The top foot of soil was dug up and buried in a pit south of the Demineralization Plant (TRA-608). An estimated 500 to 1,000 ft^3 of soil were removed and buried at this time.

Although not identified in UORs or interviews as a spill, there may have been numerous small leaks or seeps from drums that have been stored on the open loading dock (TRA-722). At least part of the ground beneath the dock is covered with asphalt. Oily stains and puddles were visible beneath the dock both times it was inspected. The extent of contamination, if any, is unknown.

4.1.3 TRA Waste Disposal Sites

Areas or sites within the TRA at which hazardous and/or radioactive wastes may have been deposited at some time are discussed in the following paragraphs.

4.1.3.1 Warm (Radioactive) Waste Leach Pond (TRA-758).

4.1.3.1.1 Description--The low-level radioactive waste pond at TRA consists of three cells and is depicted as TRA-758 on the east side of the TRA facilities in Figure 4.1.1. The first of the three cells was excavated in 1952 and has a bottom dimension of 45.7 by 76.2 m with 2:1 side slopes and a depth of 4.6 m. Because of decreased permeability and additional discharge, a second cell was excavated in 1957. That cell bottom is 38.1 by 70.1 m with 2:1 side slopes and a depth of 4.6 m. When the water level is greater than 3.4 m, these cells form one pond. The combined capacity of the two cells when water is 4.6 m is about 3.7×10^7 L.

Since use of the pond began, a precipitate of silica gel partially sealed the bottom and lower sides, thus decreasing the infiltration rate. The gel was as thick as 15.2 cm in 1961. Fine-grained sediments, algae, and other chemical precipitates were also probable contributors to decreased pond permeability. Because permeability continued to decrease, the pond water level began to rise in 1963.[3]

The third and largest cell was excavated in 1964. The cell bottom is 76.2 by 121.9 m with 2:1 side slopes and a maximum depth of about 1.8 m. The capacity of this third cell is 1.5×10^7 L when the water is 1.5 m deep. The third cell is gravity fed by the second cell through a small canal which connects the two. None of the three cells making up the warm waste leach pond are lined, but some degree of sealing has occurred because of chemical precipitates and algae.

A schematic of TRA's liquid radioactive waste collection system is shown in Figure 4.1.2. The system was designed to receive low-level liquid wastes (those with radioactivity levels small enough not to exceed discharge limits) and intermediate-level liquid wastes (those too contaminated for immediate disposal to the lithosphere). As can be seen in Figure 4.1.2, wastewater in the system goes eventually either to the seepage (leach) pond or to the ICPP for processing. The destination depends on the level of radioactivity. In some instances, wastes are held in tanks long enough for decay to bring the waste's radioactivity down to levels acceptable for discharge to the lithosphere via the leach pond. The natural absorptive and ion-exchange properties in the soil are counted on to remove most of the radioactive impurities in the water. As mentioned in Section 4.1.2.1, recent records have shown that about 72% of the wastewater reaching the collection system eventually goes to the TRA retention basin and the leach pond.

4.1.3.1.2 <u>Wastes Received</u>--The TRA warm-waste leach pond and its associated collection system were designed to handle radioactive wastewater. However, from 1952 to 1962, all liquid wastes (except sanitary

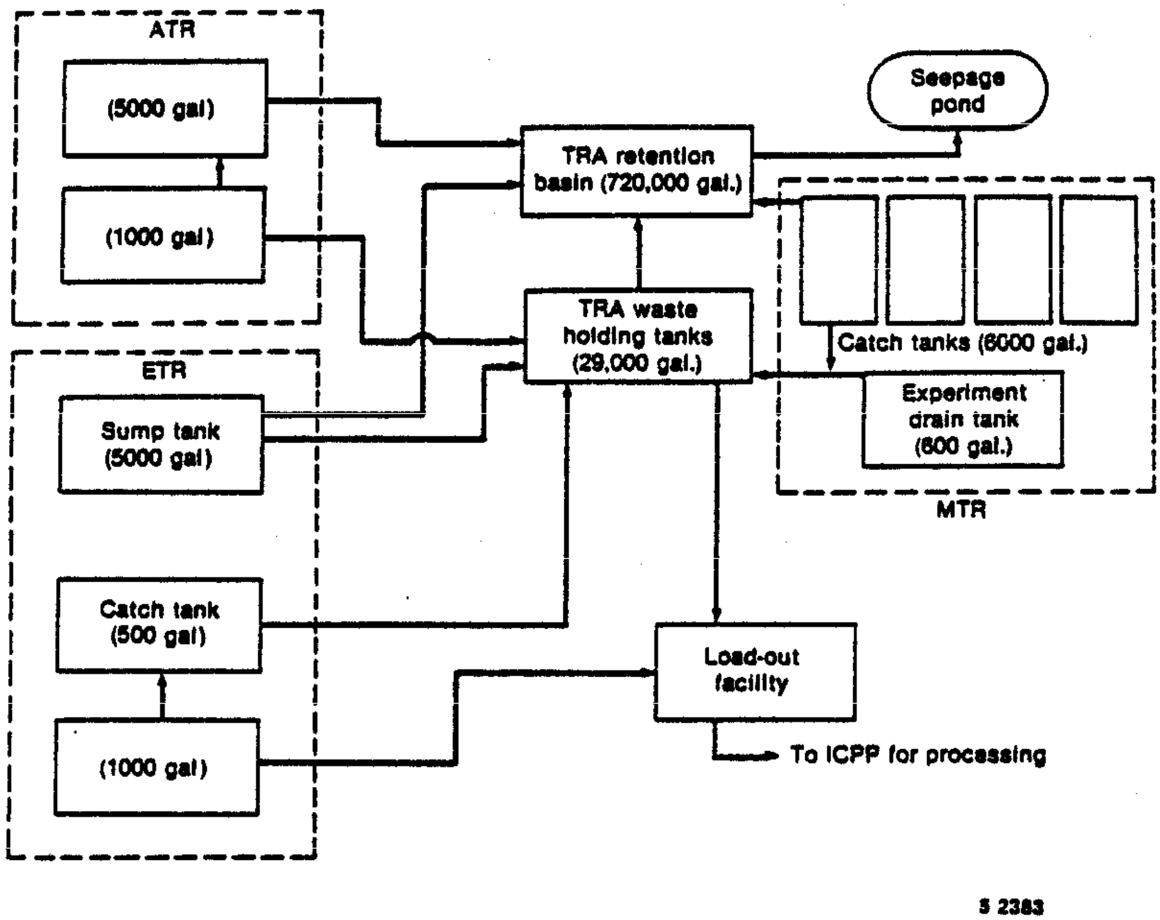

Figure 4.1.2. Past TRA radiological liquid waste collection system.

sewage) were discharged to this pond. Wastewater from the demineralization plant went to this pond until 1962 and other cold wastewater (including blowdown from the cooling towers) was discharged here until 1964. A summary of hazardous chemicals that reached the pond is provided in Table 4.1.3.

Radionuclides and water volumes discharged to the leach pond have been well documented in recent years and are part of the Radioactive Waste Management Information System (RWMIS). The average annual discharge has been about 680 million liters for the past 12 years, with volumes decreasing in the later years (i.e., 275 million liters in 1979, 225 million in 1980, and 210 million in 1981). The radioactivity discharged has also decreased in later years. From 1974 to 1978 the annual discharge to the pond averaged about 2,400 Ci (curies) of activation and fission products. By 1980, the average curie discharge was reduced to about 210 Ci, and in 1983 this trend continued, with a discharge of about 213 Ci. These reductions in radionuclide discharges were due primarily to the installation of a pretreatment facility and to reductions in the volume of wastewater being discharged. In 1983 the major nuclides contained in the discharge were: tritium (87% of total); chromium-51 (about 10%); cobalt-60 (less than 1%); and strontium-90 (less than 1%). Table 4.1.4 provides the total curies by radionuclide that were released to the warm-waste leach pond from 1961 through August 1985.

Hazardous chemical discharges have been estimated from past operations and records. From 1952 to 1961 the main TRA demineralization plant discharged regeneration solutions from ion exchange columns to the warm-waste leach pond. Regeneration of these columns is accomplished with sulfuric acid for cation columns and sodium hydroxide for anion columns. From 1957 to 1982, regenerant from the bypass demineralizer on the ETR primary cooling water system was also discharged to this pond. But at ETR only the anion resins were regenerated (discharges of sodium hydroxide only). Discharges from ion exchange regeneration accounted for approximately 700,000 kg of sodium hydroxide and 3,300,000 kg of sulfuric acid.

TABLE 4.1.3. TRA HAZARDOUS WASTE DISPOSAL SITES

Site	Site Name	Period of Operation	Area Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Waste	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
TRA-758	Warm-Waste Leach Pond	1952 - present	22,000	Low-level radioactive wastewater with: Sodium hydroxide Sulfiric acid Characteristic lab waste Chromium	 700,000 kg 3,300,000 kg 5,500 kg 12,600 kg	Discharge to open, unlined seepage pond	Active--Discharge of hazardous, non-radioactive chemicals has been eliminated	Level land/ alluvial surface sediments over basalt. Pond discharge generated a shallow perched water table at depths of about 25 to 40 meters. Primary aquifer is about 145 meters below.	No specific action taken to exclude surface drainage from reaching pond	o Monitoring shows migration to perched water tabl- and aquifer o Use of pond may be pushing contaminan further
TRA-712	Warm-Waste Retention Basin	1952 - present (leaking since early 1970s)	--	Leakage of wastewater going to warm-waste leach pond including: Sodium hydroxide Characteristic lab waste	 10,000 kg 600 kg	Leakage into soil beneath concrete basin	Active--Discharge of hazardous, non-radioactive chemicals has been eliminated	Level land/ alluvial surface sediments over basalt. Discharge contributes to perched water described above	Basin has concrete sides and top; surface drainage cannot enter	o Migration probable o Continuing leakage may be pushing contaminants furth
TRA-701	Chemical Waste Pond	1962 - present	3,200	Ion exchange regenerant solutions including: Sodium hydroxide Sulfuric acid	 1.8×10^6 kg 9.9×10^6 kg	Discharge to open unlined seepage pond. Prior to 1984 no attempt was made to neutralize before discharge	Active--Acidic and basic solutions are now neutralized before discharge	Level land/ alluvial surface sediments over basalt. Discharge contributes to perched water and aquifer described above	Pond has bermed sides that exclude surface drainage	o Migration has bee documented o Continued seepage may be pushing contaminants furt
TRA	Waste Disposal Well	1964 - 1982	N/A	Nonradioactive, clean industrial discharge. From 1964 to 1972 contained chromium-contaminated cooling-tower blowdown	13,400 kg (chromium)	Discharged directly to deep disposal well with perforations between 156 and 386 m	Closed--Well capped and sealed.	Snake River Plain aquifer is approximately 145 m from surface. Well injects directly into acquifer	Well head is sealed against surface water intrusion	o Chromium still detectable in at least one well hydraulically down-gradient fro site
TRA-606	Paint Shop Ditch	1957-1982	10	Paint thinners and solvents, specifically - Mineral Spirits - Xylene - Toluene - Acetone	 5460 L 2180 L 2180 L 550 L	Pouring in small quantities at a time into earthen ditch	Inactive-ditch used only for storm water collection	Level land/ alluvial surface sediments over basalt. Snake River Plain aquifer is approximately 145 m from surface	Ditch carries water to low areas outside facility area	

TABLE 4.1.4. CURIES RELEASED TO TRA WARM-WASTE POND (BY NUCLIDE) (1961 THROUGH AUGUST 1985)

Radionuclide	Curies Release	Radionuclide	Curies Released
(Ag) Silver-110	1.376×10^{1}	(Ru) Ruthenium-103	1.412×10^{2}
(Ar) Argon-97	6.092×10^{-2}	(Ru) Ruthenium-106	1.854×10^{2}
(Ba) Barium-140	3.944×10^{2}	(Sb) Antimony-122	4.811×10^{-2}
(Cd) Cadmium-115	4.708×10^{1}	(Sb) Antimony-124	1.863×10^{0}
(Ci) Cerium-141	3.152×10^{2}	(Sc) Scandium-46	3.904×10^{-1}
(Ce) Cerium-141	$6.268\ 10\ 10^{0}$	(Sr) Strontium-89	3.972×10^{2}
(Ce) Cerium-144	4.251×10^{2}	(Sr) Strontium-90	1.003×10^{2}
(Co) Cobalt-58	2.506×10^{1}	(Sr) Strontium-91	1.574×10^{1}
(Co) Cobalt-60	2.426×10^{2}	(Sr) Strontium-92	$7.493 \times 1\text{-}^{-1}$
(Cr) Chromium-51	1.096×10^{4}	(Ta) Tantalum-182	$1.359 \times\text{-}\ 10^{0}$
(Cs) Cesium-134	2.106×10^{1}	(Tb) Terbium-160	$1.121 \times 1\text{-}^{03}$
(Cs) Cesium-137	1.029×10^{2}	(Tc) Technetium-99M	8.918×10^{0}
(Fe) Iron-59	6.503×10^{-1}	(Te) Tellurium-132	5.559×10^{0}
(H^3) Tritium-3	7.332×10^{3}	(Te) Tellurium-192	2.888×10^{-3}
(Hf) Hafnium-181	1.487×10^{1}	Unidentified Alpha	2.876×10^{0}
(I) Iodine-129	1.377×10^{-7}	Unidentified Beta and Gamma	7.972×10^{3}
(I) Iodine-131	5.958×10^{2}	(W) Tungsten-187	3.226×10^{-1}
(I) Iodine-132	2.343×10^{0}	(Xe) Xenon-133	$4.306\ 10^{0}$
(I) Iodine-133	1.444×10^{1}	(Xe) Xenon-135	7.156×10^{-1}
(O) Iodine-135	1.100×10^{0}	(Y) Yttrium-90	6.585×10^{1}
(La) Lanthanum-140	3.051×10^{2}	(Y) Yttrium-91M	4.309×10^{1}
(Lu) Lutetium-177	1.277×10^{0}	(Y) Yttrium-92	2.357×10^{0}
(Mn) Manganese-54	1.955×10^{1}	(Y) Yttrium-93	1.455×10^{0}
(Mn) Manganese-56	$1.162 \times 1\text{-}^{-12}$	(Y) Yttrium-97	$7.\text{-}28 \times 10^{-5}$
(Mo) Molybdenum-99	1.466×10^{0}	(Zn) Zinc-65	2.858×10^{0}
(Na) Sodium-24	2.538×10^{3}	(Zr) Zirconium-95	$1.125 \times 1\text{-}^{2}$
(Nb) Niobium-95	9.232×10^{1}	(Zr) Zirconium-97	1.258×10^{0}
(Nb) Niobium-97	5.751×10^{-1}		
(Nd) Neodymium-147	4.063×10^{0}		
(Np) Neptunium-289	1.581×10^{1}		
(Re) Rhenium-188	2.102×10^{0}	Total Curies Released	3.266×10^{4}
(Rh) Rhodium-106	1.025×10^{2}		

Until mid 1984, small quantities of laboratory wastes were poured down warm-waste drains that led to the warm-waste pond. An estimated 5,500 kg of chemicals having hazardous waste characteristics, as defined by EPA, were discharged to this pond from 1952 to 1984. However, it is suspected that the characteristics were undetectable by the time these wastes reached the pond.

Cooling tower blowdown from MTR and ETR operations was discharged to the warm-waste pond from 1952 to 1963. During this time, a chromate-based corrosion preventative was added to the cooling water, and the blowdown contained significant quantities of chromium. It is estimated that 12,600 kg of chromium were discharged in this manner.

4.1.3.1.3 Evidence of Migration--Subsurface radionuclide migration from the TRA warm-waste pond has been monitored by the U.S. Geological Survey (USGS) since the pond's construction. Through this monitoring effort and associated studies, it has been determined that the liquid waste disposal systems at TRA have actually developed one if not several perched water tables above the Snake River Plain aquifer. Figure 4.1.3 is taken from a USGS study and shows a hypothesized geologic cross section at TRA, including perched groundwaters and the aquifer. Radionuclide concentrations in the primary perched water table as well as those in the Snake River Plain aquifer have been plotted. Some chemical species have also been included in the monitoring effort, and concentration distributions for these species have also been determined. Figure 4.1.4 shows the water-level contours of the perched water beneath TRA and Figure 3.7 shows the water-level contours of the Snake River Plain aquifer. (Ground level at TRA is about 4,940 feet MSL.)

One of the chemical species that has been tracked is chromium. Figure 4.1.5 shows a set of recent concentration contours for chromium in the perched water table. Cooling tower blowdown, a source of chromium discharge, was eliminated from the warm-waste pond in 1963; Figure 4.1.5 represents data taken in 1981. As would be expected, the concentration and

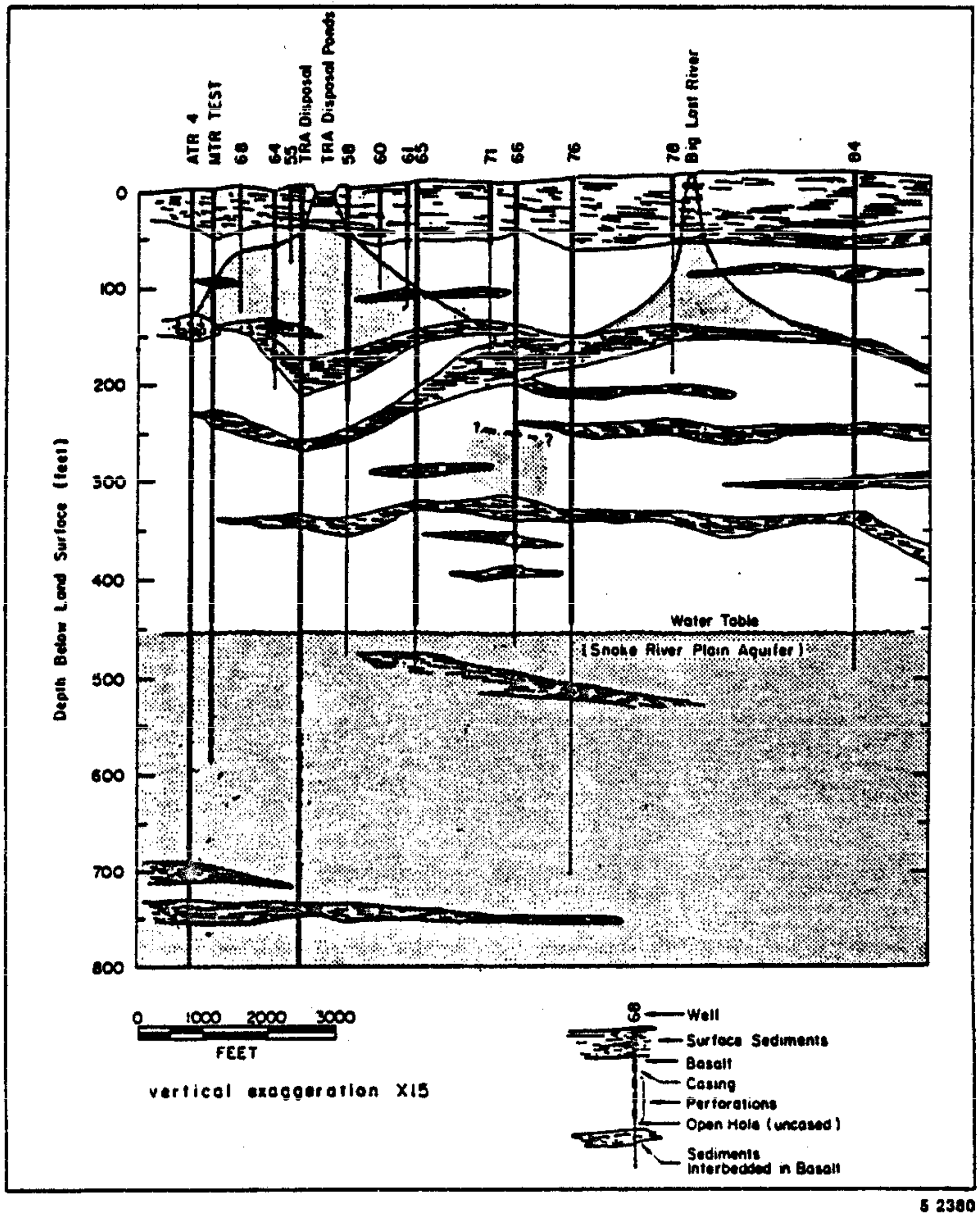

Figure 4.1.3. Geologic cross section at the Test Reactor Area showing the bodies of perched water and the Snake River Plain aquifer.

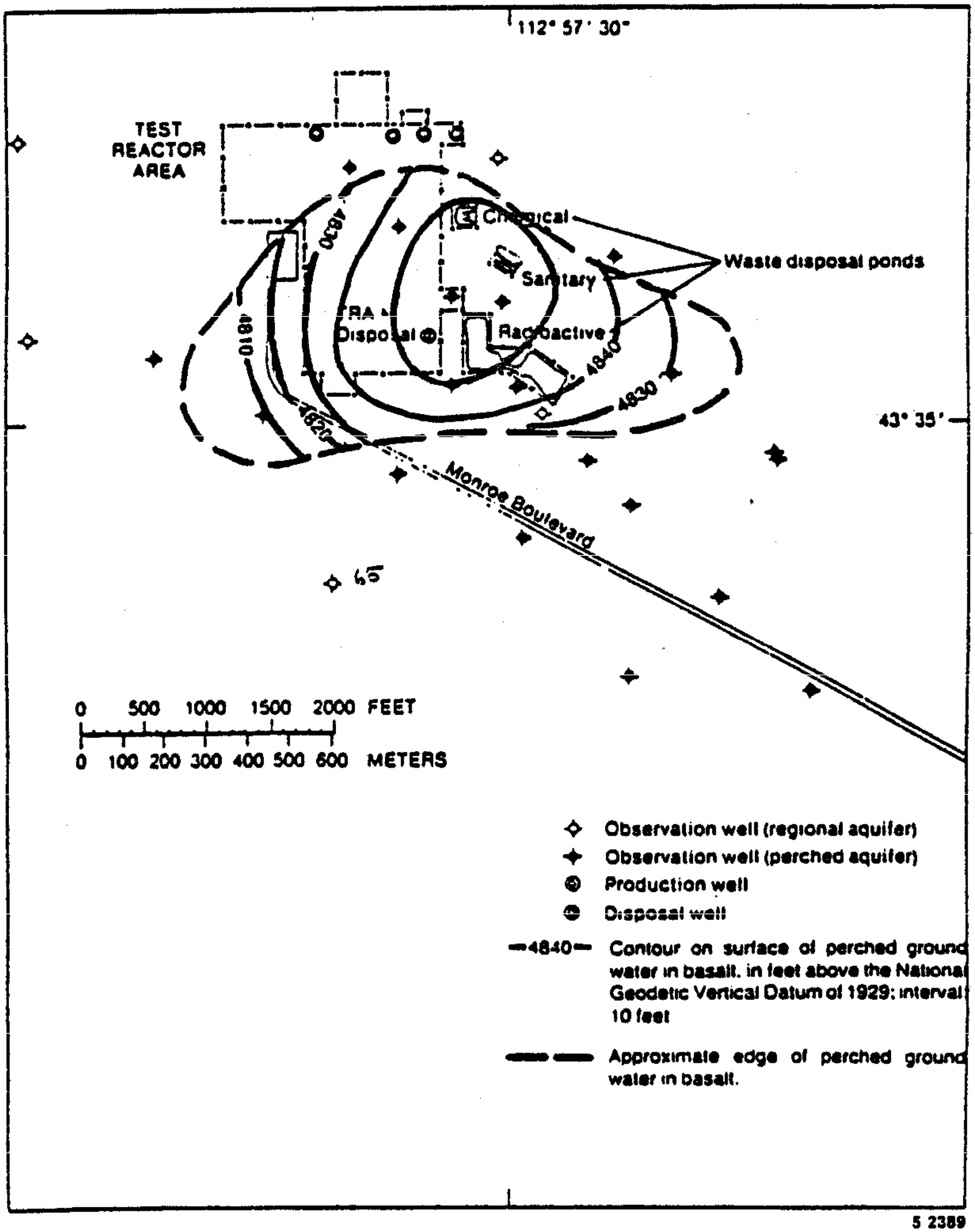

Figure 4.1.4. Water-level contours on the surface of the perched groundwater in the basalt at the TRA, October 1981.

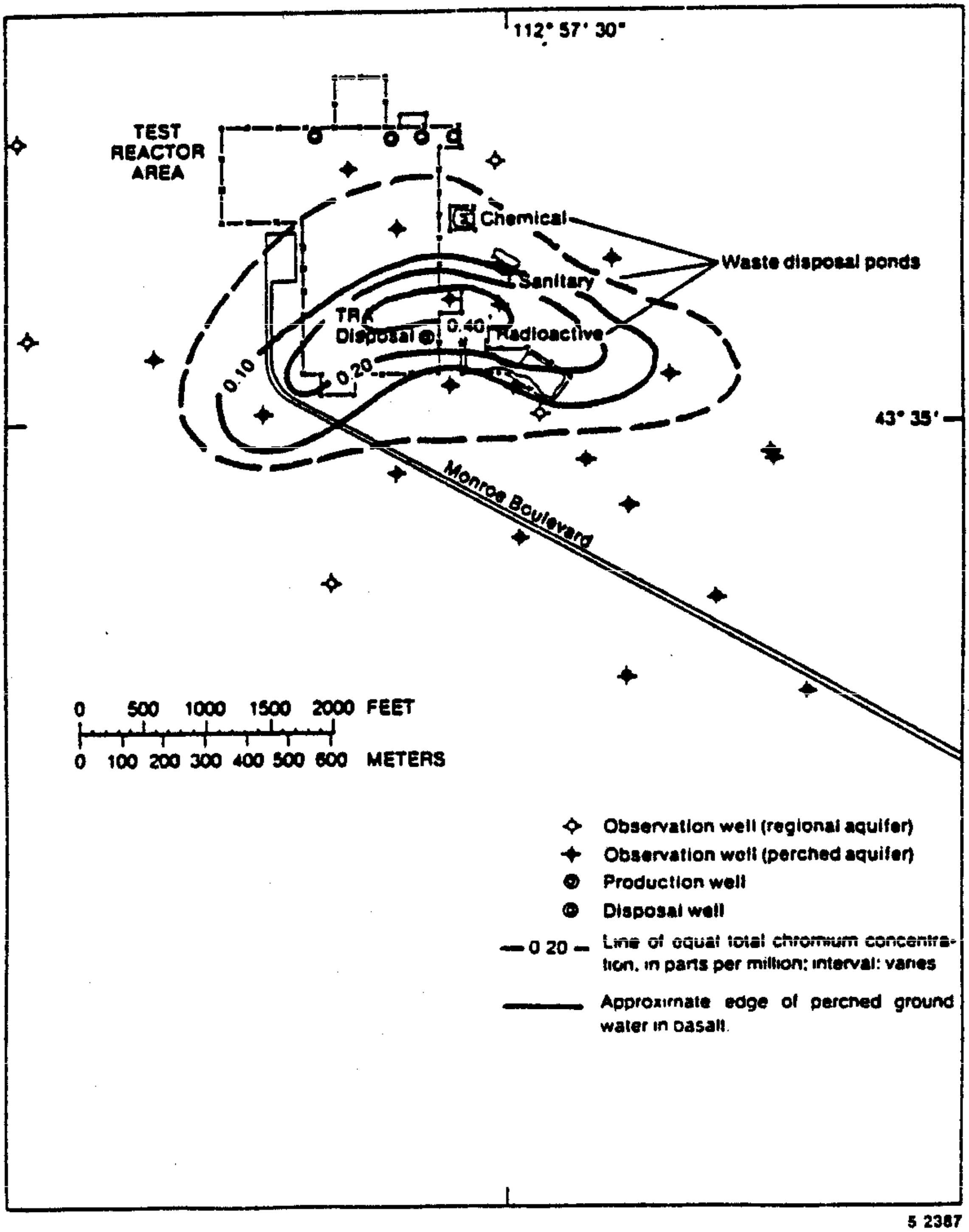

Figure 4.1.5. Total concentration of chromium in the perched groundwater in the basalt at the TRA, October 1981.

altitude contours have changed significantly over the years as the quantity and quality of wastewater and natural recharges (Big Lost River) have changed, but the chromium is still present. The radionuclide tritium, which migrates and evaporates as does the water with which it is mixed, has also been monitored. Tritium and other radionuclides have been detected in the Snake River Plain aquifer and are assumed to have migrated from the warm-waste pond via the perched water table. It can be assumed that past discharges of chromium had the same route available, but the ion-exchange capacity of the ground may have had more impact on removal because no measurable chromium levels in the groundwater have been definitely linked to the pond operations.

Specific conductance has also been tracked in USGS monitoring wells and provides a good measure of the dissolved chemicals that have been discharged to the ground. In this instance, a prime source of dissolved chemicals is the regenerant from ion exchange columns. Recent specific conductance contours indicate elevated levels in both the TRA perched water table and the Snake River Plain aquifer directly below. The chemical disposal pond (TRA-701) has most recently been the disposal site for dissolved chemicals and will be discussed later, but again it can be assumed that the same migration took place when regenerants were discharged to the warm-waste pond.

4.1.3.2 <u>Warm-Waste Retention Basin (TRA-712)</u>.

4.1.3.2.1 <u>Description</u>--All wastewater discharged to the TRA warm-waste leach pond must first pass through the retention basin as shown in Figure 4.1.2. The retention basin consists of two underground rectangular concrete tanks separated by a 1-ft-thick concrete wall. It is located just east of the ETR facility, and its outline is shown in Figure 4.1.1 as facility number 712. These tanks were designed to receive radioactively contaminated water and to delay its passage for a sufficient time for short-lived radioactive contaminants to decay before being discharged to the leach pond. The total capacity of the basin is about 2.7 million liters (720,000 gallons) which can be equally divided between the two tanks.

4.1.3.2.2 Water Received--Since at least the early 1970s, the retention basin has been leaking at a rate of 10 to 20% of the total inflow. Operators do not know whether the basin was leaking prior to that time. Depending on when the leaking started, some or all of the hazardous constituents identified as going to the warm-waste leach pond can also be assumed to have been discharged in smaller quantities to the ground beneath the basin. Discharges of most hazardous chemicals to the warm-waste system were eliminated in the early 1960s. If it is assumed that the basin was not leaking at that time, then only portions of the lab wastes and the ETR bypass demineralizer regenerant were lost from the basin (along with the radioactive wastewater). As much as 5,000 to 10,000 kg of sodium hydroxide and 300 to 600 kg of characteristic lab waste may have been lost from the retention basin.

4.1.3.2.3 Evidence of Migration--The warm-waste retention basin and the warm-waste leach pond are in close enough proximity that subsurface contamination in the area could be from either source or from both. However, USGS personnel have stated that the elevation of the perched water table described earlier varies, depending on which of the two tanks within the basin is holding water. This would appear to substantiate that at least one tank contributes to the perched water table through leaks and, more importantly, that migration of contaminants is possible by the same logic applied to the warm-waste pond. (The retention basin discharges to the perched water table which, in turn discharges to the Snake River Plain aquifer).

4.1.3.3 Chemical-Waste Pond (TRA-701).

4.1.3.3.1 Description--The chemical-waste leaching pond was constructed north of the warm-waste leach pond (see Figure 4.1.1) and was first used in 1962. The pond was constructed primarily to lessen the hydraulic load on the warm-waste leach pond. The chemical-waste pond floor is 51.8 by 51.8 m, has 1:1 side slopes (about 2.44 m high), and contains 5.8×10^6 L when the pond is 2 m deep. However, the rated capacity is 4.4×10^6 L. The pond is unlined and has earthen bottom and sides.

4.1.3.3.2 <u>Wastes Received</u>--The pond was designed to receive chemical wastes from the TRA demineralization plant. The wastes consist of regeneration solutions from the plant's ion exchange units and alternately contain sodium hydroxide and sulfuric acid. Discharges to the pond have decreased over recent years as the ETR operations phased down; 7.9×10^7 L were discharged in 1978, as compared to 2.5×10^7 L in 1983. It is estimated that from 1962 to mid-1984 wastewater discharged to the chemical-waste pond contained 1.8×10^6 kg of sodium hydroxide and 9.9×10^6 kg of sulfuric acid. Since mid-1984 the wastes are neutralized before discharge to the pond.

On occasion, other corrosive wastes have been added to the pond. At one point during the past several years, bags containing waste sulfuric acid and sodium hydroxide were dumped down the pond banks. The chemical wastes originated from cleaning out the acid and caustic trenches in the TRA utility area. Records of that incident were not maintained, but it is estimated that three or four 55-gal drums were dumped. Also, a supporting structure was built into the west bank of the pond to brace tanks to be drained into the pond. In August 1982, a 1,900-L tank containing battery acid from the vehicle service facility at the Central Facilities Area (CFA) was drained into the pond.

4.1.3.3.3 <u>Evidence of Migration</u>--Specific conductance, a good measure of dissolved chemicals, has been monitored in both the perched water table under the wastewater disposal area of TRA and in the Snake River Plain Aquifer further down. Recent contours for specific conductance in the perched water table are shown in Figure 4.1.6. As indicated by the contours, the source of the elevated specific conductance definitely appears to be the chemical-waste pond. This figure presents good evidence that migration has occurred, but not necessarily as hazardous waste.

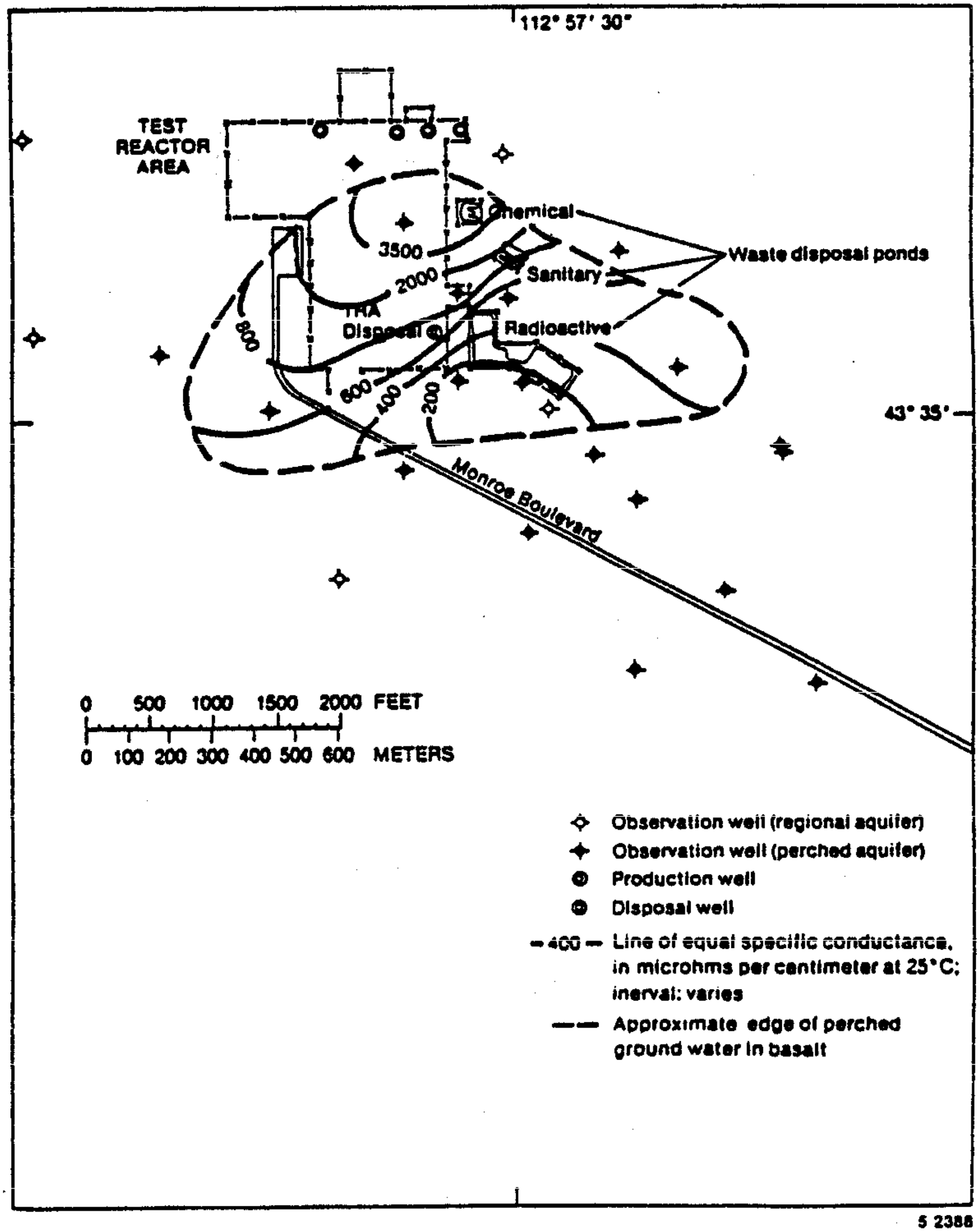

Figure 4.1.6. Specific conductance of perched groundwater in the basalt at the TRA, October 1981.

Figure 4.1.7 shows specific-conductance contours for the underlying Snake River Plain aquifer. Again, there appears to be a definite connection between surface operations and elevated specific-conductance levels. The most obvious possible connection is from the chemical waste pond via the perched water table.

4.1.3.4 Waste Disposal Well.

4.1.3.4.1 Description--The TRA waste disposal well (see Figure 4.1.1) was drilled during 1962 and 1963 for disposal of nonradioactive liquid wastes. The well is 387.4 m deep and is cased to the bottom, with casing ranging in diameter from 15.2 to 45.7 cm. The well is perforated at several intervals between 156 and 386 m below land surface. Disposal began in 1964, and yearly discharges have ranged from 19 million liters in 1964 to over 1,100 million liters in 1974. The well has been capable of accepting rates equal to almost 2,000 million liters per year, with no detectable head buildup. The well was used until March 1982, when effluents disposed of in the well were diverted to the new cold-waste ponds. A locked metal cap has been placed on the well opening.

4.1.3.4.2 Wastes Received--Cooling tower blowdown furnishes the bulk of the nonradioactive or cold wastes that went to the disposal well, but water from air conditioning units, secondary system drains, and other nonradioactive drains at the reactors and supporting facilities was included. The hydraulic test facility, a metallurgy laboratory, hot cells, a steam plant, and the ETR compressor building were connected to this system. Small quantities of chemicals were added to the water for pH corrosion and quality control. These chemicals included sulfuric acid, chlorine, phosphates, corrosion inhibitors, and algae inhibitors. The wastes from these sources contained about 500 ppm dissolved solids, primarily water "hardness" salts of calcium and magnesium. On rare occasions the wastes may have been diverted to the warm-waste retention basin. Diversion to the retention basin generally occurred only when detectable radioactive contamination was found in the wastes.

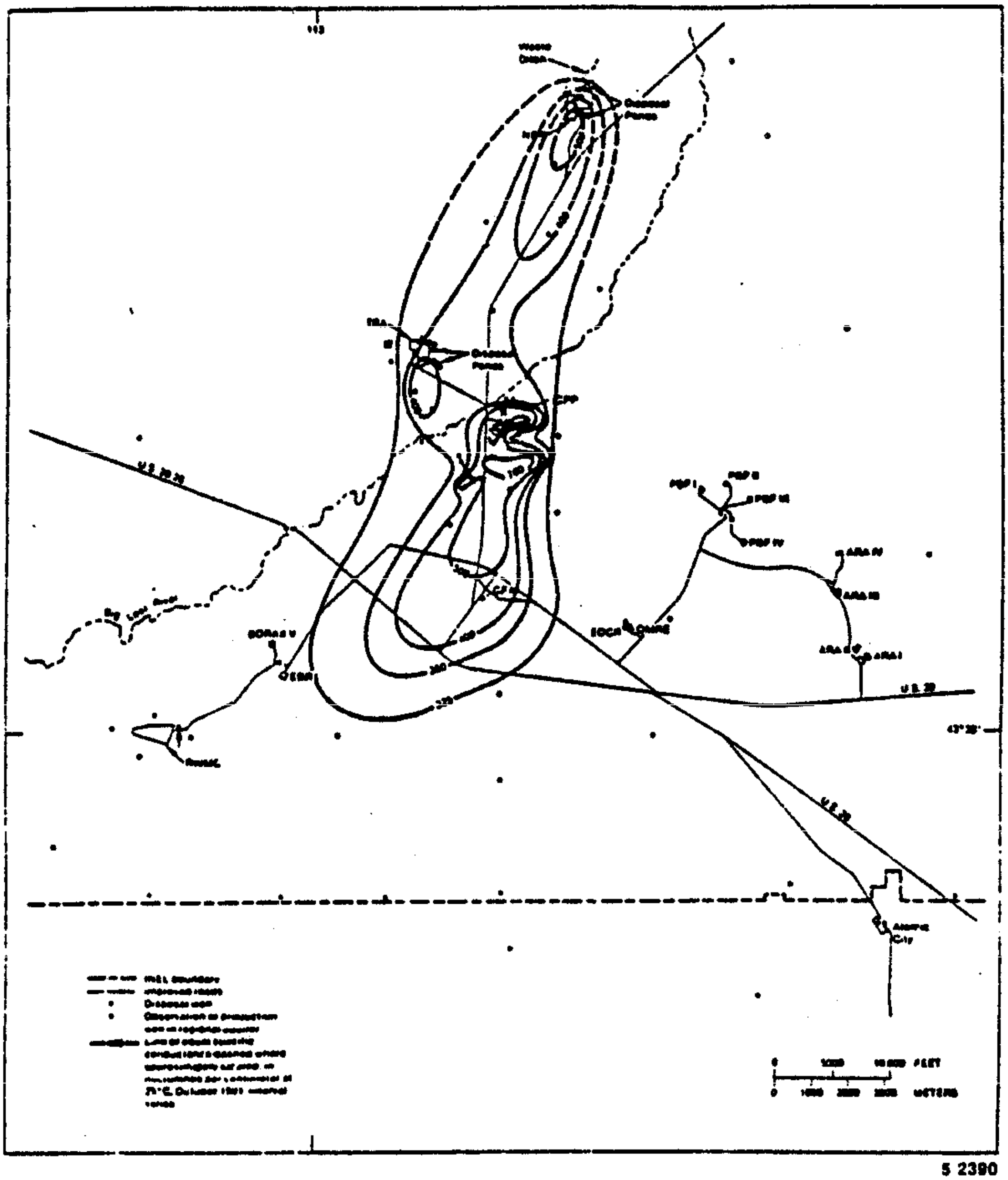

Figure 4.1.7. Specific conductance of water samples from the Snake River Plain aquifer, south-central INEL vicinity, October 1981.

Of the wastes going to the disposal well, the one of primary concern is the cooling tower blowdown that was discharged prior to September 1972. That was the date that the chromate-based corrosion inhibitor was replaced with an organic-silicate-phosphate inhibitor. From 1964, when the well was first used, until September 1972, it is estimated that 13,400 kg of chromium were discharged to the disposal well.

4.1.3.4.3 Evidence of Migration--The USGS monitoring of groundwater in the area of TRA has shown detectable levels of chromium in both the perched water table and the Snake River Plain aquifer. Chromium levels in the perched water were shown in Figure 4.1.5. Past monitoring of the acquifer indicated a chromium plume when chromium was being discharged to the disposal well. For about the past ten years, USGS Well 65, located approximately 1,500 feet south of TRA and shown in Figure 4.1.4, has also shown chromium levels ranging from about 0.3 to 0.4 mg/L. It is unknown whether these levels are due to past disposal operations or are naturally occurring.

4.1.3.5 Paint Shop Ditch (TRA-606)

4.1.3.5.1 Description--This shallow storm water collection ditch is located just east of the paint shop. The ditch is unlined, has natural earthen sides and bottom, and was designed simply to channel small flows of precipitation out of the immediate area.

4.1.3.5.2 Wastes Received--The only wastes suspected of reaching this ditch were those generated by the TRA-606 paint shop. Prior to 1983 small quantities of paint thinners and solvents were dumped here as they were generated. The data in Table 4.1.3 is based on the estimate that 420 liters (55 gallons) of waste were disposed of each year and that they consisted of 50% mineral spirits, 20% xylene, 20% toluene, 5% acetone, and 5% water. This estimate is felt to be conservative and does not take into account any evaporation which was undoubtedly significant, particularly during summer months.

4.2 TAN/TSF Past Activity Review

4.2.1 TAN/TSF Description

The mission of the Test Area North/Technical Support Facility (TAN/TSF) is to provide unique facilities for the support of energy research and defense programs, and to maintain specialized facilities for technical engineering and radioactive materials handling programs, as well as for other INEL programs. The TAN/TSF area is located in the north central portion of the INEL, as was shown in Figure 3.3. TAN is approximately 27 miles northeast of the Central Facilities Area (CFA). Development of TAN/TSF began in the early 1950s to support the Aircraft Nuclear Propulsion (ANP) Program. TAN reactor and hot shop operations began in 1955. The TSF facilities have been modified over the past 30 years to fit the changing needs of the INEL.

The TSF facilities can be broken into several functional categories that correspond to general sections of the area. They are:

1. The Administrative and Technical Support Section: Looking at the plot plan of Figure 4.2.1, this section lies between the guardhouse area on the east (TAN 601/602) and the earth berm on the west. It contains administrative and office buildings, a guardhouse, service and maintenance shops, a small machine shop, and a newly constructed multicraft shop.

2. The Manufacturing and Radioactive Materials Handling Section: This section centers around Building TAN-607 (see Figure 4.2.1). It consists of a complex of buildings which includes: A manufacturing, assembly and hot shop building; a pump station; a fuel assembly and storage facility; and a hot liquid waste pump building. Located immediately west of the TAN-607 complex are: A carpentry shop, a gas cylinder storage area, a liquid waste transfer and storage facility, and a four-rail railroad system with a turntable.

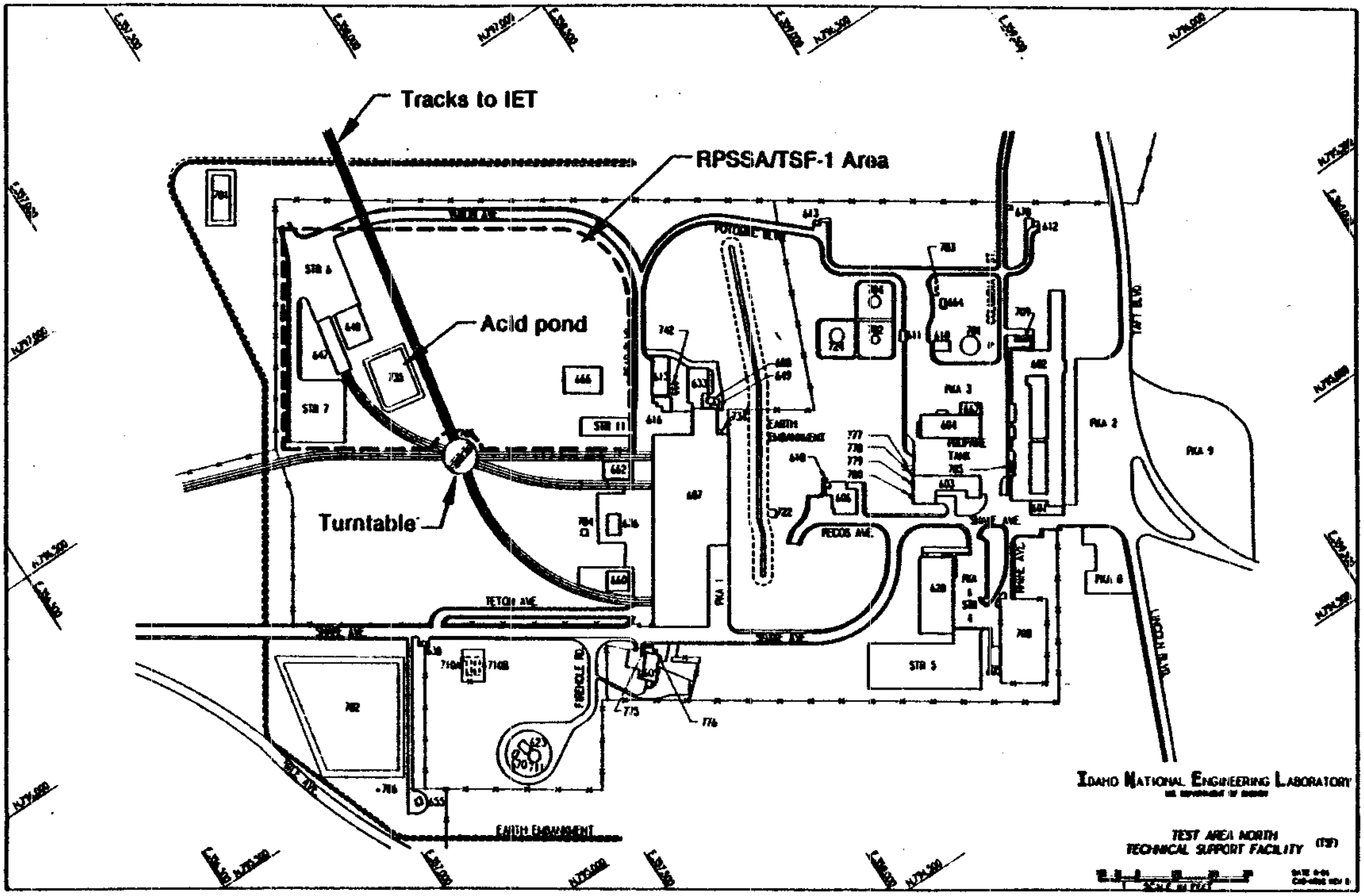

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Figure 4.2.1 Test Area North/Technical Support Facility (TAN/TSF) plot plan.

3. The Radioactive Materials Storage Section: This section is located west of the TAN-607 complex and consists of the dolly storage building (with access by the four-rail track), the Radioactive Parts Security Storage Area (RPSSA) and an outside pond (TAN-735 on Figure 4.2.1). The RPSSA includes the presently used open storage areas (str 6 and 7) and the field area to the east where radioactively contaminated materials have been stored and even buried in the past.

4. Utility Sections: The utility functions can actually be divided into north and south areas. One is on the north side of the Administrative and Technical Support Section and contains a water tank, a No. 2 fuel oil tank, two No. 5 boiler fuel oil tanks, two water wells and associated pumping facilities, an electric substation, and a vehicle service station. The other utility section runs along the south border of TSF and includes the main electric substation, two liquid-waste storage holding tanks, a sewage treatment plant, a liquid-waste lift station, a sanitary-waste settling pond, and a surface run-off water-retention basin.

4.2.2 TAN/TSF Wastes Generated by Specific Activity

4.2.2.1 TAN/TSF Maintenance, Manufacturing, and Utility Operations. The areas identified in Table B-1 of Appendix B were screened further to produce a list of TAN/TSF shops, labs, and processes which were considered to pose a potential for contamination. Table 4.2.1 provides the refined list of facilities and also provides the hazardous waste constituents involved, the timeframes in which the hazardous wastes were produced, and the disposal methods. The facilities in Table 4.2.1 are further discussed in the following paragraphs.

TABLE 4.2.1. TAN/TECHNICAL SUPPORT FACILITY--WASTE GENERATION

Shop Location	Function	Waste Stream	Timeframe	Estimated Quantities (if known)	Treatment/Storage/Disposal
TAN-604	Maintenance shop	Paint thinner and solvent	1956-1972	19 L/yr	TSF injection well via sewage plant
			1972-1984	19 L/yr	TSF disposal pond via sewage plant
			1984-Present	19 L/yr	Off-site T/S/D
TAN-607	Chemical cleaning room (pipe laundry)	Corrosive liquids (acids and caustics, but drained separately)	1955-1972	17,000 L/yr	TSF injection well
			1972-1974	17,000 L/yr	TSF disposal pond
	Decontamination room	Corrosive liquids (acids and caustics, but drained separately)	1955-1975	12,200 L/yr	TSF intermediate-level waste disposal system
			1975-1984	12,200 L/yr	ICPP
		Oxalic acid solution	1955-1975	4,200 L/yr	TSF intermediate-level waste disposal system
			1975-1984	4,200 L/yr	ICPP
	Sandblast room	Potentially radioactive and EP Toxic spent sandblast media	1955-1984	--	RWMC
	TAN hot cell (THC)	Decontamination solutions			
		Corrosive wastewater	1955-1969	8,000 L/yr	TSF intermediate-level waste disposal system
		Corrosive chemicals	1970-1974	715 kg/yr	TSF intermediate-level waste disposal system
		Potassium hydroxide	1970-1974	540 kg/yr	TSF intermediate-level waste disposal system
		Potassium chromate	1970-1974	35 kg/yr	TSF intermediate-level waste disposal system
		Potassium permanganate	1970-1974	140 kg/yr	TSF intermediate-level waste disposal system
		Oxalic acid	1970-1974	110 kg/yr	TSF intermediate-level waste disposal system
		Ammonium oxalate	1970-1974	570 kg/yr	TSF intermediate-level waste disposal system

TABLE 4.2.1. (continued)

Shop Location	Function	Waste Stream	Timeframe	Estimated Quantities (if known)	Treatment/Storage/Disposal
TAN-607	Photo lab and cold preparation lab	Corrosive photo developing solution	1955-1972	Small	TSF injection well
			1972-1982	Small	TSF disposal pond
TAN-609 (previously 604)	Auto mechanics shop	Oil with small quantities of hydraulic fluid and stoddard solvent	1956-1967	950 L/yr	Applied to dirt roads in TAN area for dust suppression or burned
			1967-1977	950/L/yr	Applied to dirt roads
			1977-1982	950 L/yr	Part for dust suppression part to oil recycler
			1982-present	950 L/yr	Collected by oil recycler
TAN-633	Hot Cell annex	Decontamination solutions and etching acid	1958-1972	Small	TSF intermediate-level waste disposal system
TAN-649	Water filtration building	Radioactively contaminated ion-exchange resins	1960-present	--	RWMC for burial

TAN-603. The boiler plant in TAN-603 provides steam for TSF. Plant operators add phosphate- and sulphate-based treatment chemicals to the boiler makeup water to prevent scaling and corrosion. It is estimated that about 45,000 liters (12,000 gallons) of blowdown water is sent annually to the sanitary sewer from this facility. However, these chemicals, particularly in the concentrations in which they are found in the blowdown water, are not considered hazardous. The boiler plant also operates water softeners for the makeup water. The brine solutions from regeneration of these softeners likewise goes to the sanitary sewer.

TAN-604. TAN-604 has traditionally been used as a maintenance shop and includes parts and equipment storage, paint storage and mixing area. Paint mixing and cleaning operations have produced hazardous wastes. Painting operations are relatively small, and paint thinners and solvents are generally reused until they are no longer effective or until the odor becomes bothersome. During their use and reuse the materials are kept in 5-gal drums. It is estimated that only about 19 liters (5 gallons) of waste are generated each year. These ignitable wastes are now put into drums and shipped off site as hazardous waste; however, until mid-1984, they were probably poured down the shop drains or sinks which are connected to the sanitary sewer system. Although significant quantities of each waste would undoubtedly be evaporated or biologically destroyed by the time it passed through the TAN/TSF sewage treatment plant, the most conservative estimate would be to assume that the hazardous waste passed through the plant and was discharged to either the TSF injection well or the disposal pond (TAN-736). The receiving site would depend upon the timeframe of the discharge. (It should be noted that TAN-636 is also identified as containing a paint shop. However, mixing and cleaning of paint materials used in TAN-636 is accomplished in the TAN-604 facility.)

TAN-607. The TAN-607 facility is the heart of the TSF Manufacturing and Radioactive Materials Handling Section. It contains a hot shop, a hot cell, a water pit, a warm shop, and multiple crane and manipulator services. Until recent (1985) modifications, the facility also contained craft shops, a machine shop, a high-bay assembly shop, and cleaning rooms. Those areas suspected of generating hazardous and/or radioactive wastes are discussed in the following paragraphs.

Three cleaning rooms were located in TAN-607. These were the sandblast room, the chemical cleaning room, and the decontamination room. Normally, generation of radioactive waste was limited to the decontamination room. Although each of the three cleaning rooms was designed for a distinct function, together they provided an integrated cleaning capability.

The chemical cleaning room, often referred to as the pipe laundry, was normally used for the industrial cleaning of nonradioactively contaminated components and piping. It contained six cleaning tanks: One tank was a rinse tank and was drained frequently; the other five varied in content from caustic to acidic and were changed out about once a year. Each tank contained about 3400 liters (900 gallons), so it can be assumed that about 17,000 liters of corrosive liquids were drained each year to the process drains that serviced this room. Again, depending upon the timeframe of the discharge, this waste went to either the TSF injection well or the TSF disposal pond. Beginning about 1975, trisodium phosphate was used as the cleaning solution rather than corrosive liquids. A trichloroethylene vapor degreaser was also located in the chemical cleaning room. It had a 5,680-liter (1500-gallon) solvent capacity. In addition to the steam-heating coils in the bottom, it had a heavy vapor middle section and cooling coils to condense the vapors in the upper cold water section. The vapor degreaser was not used heavily and was operated so that there was no drag-out of solvent on the cleaned parts.

The decontamination room provided capability for using chemical solutions to remove loose radioactive materials from components and piping. These chemical solutions became radioactively contaminated and were discharged to the TSF intermediate-level waste disposal system. The decontamination room also had six solution tanks: Three 1900-liter (500-gallon) tanks on the north side of the room and three 4200-liters

(1100-gallon) tanks on the south side. One 1900-liter tank contained an acid solution, one contained a caustic solution and the third contained an oxalic acid solution. One of the 4200-liter tanks contained rinse water only, while the other two contained acid and caustic solutions respectively. It is estimated that each of these tanks were drained once a year or less.

The sandblast area contained one large Pangborn sandblasting room and an adjacent glove box sandblaster for small items. The used sandblast media has always been considered potentially radioactively contaminated and has been taken to the RWMC for disposal. It is unknown whether or not the sandblast media would be considered hazardous because of any heavy metal contamination.

The TAN Hot Cell (THC) in TAN-607, formerly referred to as the Radioactive Materials Laboratory, consists of a hot cell and control galleries. It is used for study, observation, and analysis of small radioactive objects, as well as for disassembly and examination of fuel rods. Wastes are generated when the interior of the cell is washed out to remove radioactive surface contamination.

Prior to 1975, the cell was washed out frequently (possibly as often as once a month) using 570 to 760 liters (150 to 200 gallons) of cleaning solution. The cleaning solution then drains to the intermediate-level waste disposal system. From 1955 to 1970 the cleaning solutions were simply acidic or caustic. From 1970 to 1975 TURCO products 4502, 4518 or 4521 were used to make up the solutions. These were powder products and were mixed in water at concentrations of 120 to 240 g/L (1 to 2 lb/gal). The active ingredients of TURCO 4502 are 75% potassium hydroxide, 5% potassium chromate and 20% potassium permanganate; ingredients of TURCO 4521 are 15% oxalic acid and 80% ammonium oxalate; specific ingredients of TURCO 4518 are unavailable on site, but the material produces an acidic solution. The three solutions were altered in use, but anytime TURCO 4502 was used a follow-up wash with TURCO 4518 or 4521 was required because of the purple color (due to potassium permanganate) left by the 4502 solution.

For the estimated quantities in Table 4.2.1 it is assumed that the TURCO 4521 and 4518 solutions were each used for six washdowns a year. Since it was used in conjunction with one of the above, it will also be assumed that the TURCO 4502 solution was used six times a year.

The THC has been washed less frequently since 1975 because of a change in the method of handling wastewater that goes to the intermediate-level waste disposal system. (Since 1975 this wastewater has been trucked to the ICPP for treatment.) In order to reduce wastewater volumes, the THC is now washed only about three times a year. Also since 1975 only detergent solutions have been used to wash out the cell.

The Hot Shop facilities within TAN-607 are designed to provide remote servicing and maintenance of nuclear experimental assemblies. The shop is not a normal use area for chemicals but does involve occasional decontamination operations and decontamination solutions. Radiacwash (a brand name detergent) is sometimes applied with rags or wipes and the waste materials thrown into hot-waste receptacles. Occasional washdowns with water and detergents go to drains leading to the intermediate-level waste disposal system. Any solid or liquid waste generated in this facility would be suspected of having radioactive contamination and would be treated accordingly. However, there appears to be no evidence of hazardous (chemical) wastes being generated from normal operations.

In past years, a small photo lab has been operated in TAN-607. Corrosive waste developing solutions have been generated and discharged. It is suspected that rinses were discharged to the process waste collection system while actual solutions were sent to the intermediate-level waste disposal system. From about 1965 to 1970 a cold preparation lab was also operated in the upstairs portion of TAN-607 (area now used as office space). Small quantities of photochemicals were also discharged to the process drain from this operation, as were small quantities of etching acid.

The auto mechanics shop at TSF was located in TAN-604 until 1983 when it was relocated to TAN-609. Work done at this shop is limited primarily to preventive maintenance on government vehicles. Wastes generated are limited to oils, hydraulic fluids, and small amounts of solvents used for cleaning parts. Approximately 950 liters (250 gallons) of waste oil are generated per year from this shop. From 1956 to about 1967, the waste oils were either burned (at the TSF burn pit until 1958, then at the WRRTF burn pit) or were accumulated and occasionally spread on dirt roads in the TAN area for dirt suppression. From 1967 to 1977 the TAN burn pits were closed down, and it is assumed that the waste oil was used solely as a dust suppressant. From 1977 to about 1982 or 1983 when the practice stopped, only portions of the oil were used in this manner.

Beginning in about 1977, some of the oil was collected from drums by a commercial oil recycler. Since the practice of using waste oil for dust suppression stopped, all waste oil is collected for recycling. The small quantity of waste hydraulic fluid generated is mixed with the waste oil. Small parts cleaning is now accomplished in leased "Saf-T-Clean" units which are periodically serviced by the owner, who provides new solvent and takes the old material off site, presumably for recycling. Prior to this arrangement Stoddard Solvent was used for small parts cleaning and was mixed with the waste oil when it was spent.

The Hot Cell Annex in TAN-633, like the THC, is set up for the remote handling and examination of radioactively contaminated materials. The facility has been essentially unused since about 1971 or 1972. Radioactive contamination was the primary concern for any waste generated from this facility so the facility had drains connected to the intermediate-level waste disposal system. Wastes from the site were primarily limited to the decontamination solutions occasionally used. However, one cell was set up for metallography work and did involve small discharges of etching acid.

The Water Filtration Building, TAN-649, is a concrete vault that houses water filtering system equipment and chemistry control equipment. The equipment is used to maintain the quality of the storage pool water in TAN-607. The ion-exchange system used to maintain water quality uses disposable resins; therefore, no acidic or caustic regenerants are present. The depleted resins are radioactively contaminated and are shipped to the RWMC for disposal.

The Service Station, TAN-664, is a small facility, limited in use to dispensing of gasoline, propane, motor oil, windshield washer fluid and antifreeze. There is no vehicle maintenance done there and, with the exception of empty containers, no wastes generated. However, the site is occasionally used for car washing, and, in some instances Stoddard Solvent will be applied by hand to the vehicles to remove stains. Washwater is allowed to drain away from the service station into the surrounding dirt areas. The quantities of possible hazardous wastes involved are felt to be insignificant.

4.2.2.2 TSF Fuels/Petroleum Management. Bulk fuel usage at TSF consists primarily of No. 2 and No. 5 fuel oil which is burned in boilers, gasoline for vehicles, and diesel fuel for buses. There are several other small tanks in the area, mostly associated with standby power generators. The product is delivered to TSF in tank trucks and pumped to the various above and belowground tanks. The largest tanks at TSF are TAN-702, -704, and -724; they hold fuel oil, are aboveground, and are surrounded by earthen berms. This oil is piped to the boiler facility, TAN-603, via the fuel pumphouse, TAN-611. The next largest tanks, TAN-664 and -792, are underground and hold gasoline and diesel fuel respectively. These tanks are located adjacent to their dispensing facilities. Table 4.2.2 provides an inventory of the fuel/petroleum storage tanks at TSF.

There have been no Unusual Occurrence Reports (UORs) on spills from the tanks described in the preceding paragraph. However, according to interviews, there have been unspecified occasions when fuel oil has been

TABLE 4.2.2. TSF-FUEL/PETROLEUM STORAGE TANKS

Location or Tank Number Location	Oil Type	Maximum Capacity (g)	Above (A), Underground (U), Outside (O), Inside (I)	Level Check	IMMS Number	Responsibility	Comments
TAN-603 (TSF)	Diesel No. 2	1,000	U, O	Dipstick	--	Plant services	--
TAN-603 (TSF)	Diesel No. 2	75	A, I	Automatic gauge on pump line	--	--	Curbing; filled from underground tank
TAN-607 (TSF)	Diesel blend	2,500	U, O	--	01SSW611	Transportation	Abandoned
TAN-607 (TSF) (Room 142)	Diesel blend	300	A, I	Automatic gauge on pump line	--	--	Curbing; filled by line from TAN-722
TAN-610 (TSF)	Diesel No. 2	300	A, I	Outside gauge	--	Plant Services	Curbing
TAN-610 (TSF)	Gasoline	300	U, O	--	--	--	Abandoned
TAN-664 (TSF)	Unleaded gasoline	12,000	U, O	Dipstick	01SSW603	Transportation	--
TAN-702 (TSF)	No. 5 fuel oil	101,464	A, O	Dipstick	01BFW659	Plant services	--
TAN-704 (TSF)	No. 2 fuel oil	190,343	A, O	Dipstick	01BFW649	Plant services	--
TAN-724 (TSF)	No. 5 fuel oil	190,343	A, O	Dipstick	P1BFW660	Plant services	--
TSF	Diesel No. 2	2,000	A, O	--	--	Transportation	Temporary; near TAN-722
TAN-792 (TSF)	Diesel fuel	10,000	U, O	--	--	Transportation	Bus fuel station tank

spilled inside the bermed area around Tanks 702, 704 and 724. Since there were no UORs on such incidents, it is assumed they were minor, if in fact, they did occur. Other spills and UORs are addressed in the next section.

Oils, lubricants, and small amounts of solvents are most often delivered to TSF in 55-gallon drums which are generally held at their place of use. Empties that are not used to collect the used materials are sent back to CFA for salvage.

4.2.2.3 Spills Within the TSF. Personnel interviews, site observations and review of UORs provided information on the spills identified in this section.

In 1959 or 1960, three drums of sulfuric acid being stored at TSF apparently went bad as there were obvious signs of pressurization (bulging drums). The three drums were taken to a gravel pit approximately 1.6 to 2.4 kilometers (1 to 1.5 miles) northwest of TSF to be dumped. One drum was opened with a long-handled bung wrench, but the pressure released was so great that it was decided it would be unsafe to open the other two in this manner. The drums were then taken to the Liquid Corrosive Chemical Disposal Area (LCCDA) near the RWMC and drained into the pit by having security police shoot them from a safe distance.

In the early 1970s, the TSF intermediate-level waste disposal system included an evaporator that concentrated radioactively contaminated wastewater. Basically the condensate was discharged to the process waste system and the concentrate, being too contaminated for discharge, was held in tanks. In this time frame a leak occurred (corrosion was the suspected cause) in the steam jacket that provided heat to the evaporator. Radioactive contamination migrated to the steam system and caused higher-than-allowed levels of radioactivity to be discharged to the process waste system and ultimately be the TSF injection well. This disposal system is described further in Section 4.2.3.3.

In the 1980-81 timeframe it was discovered that the V-2 tank (part of TAN-742) in the intermediate-level waste disposal system was contaminated with oil containing PCBs. The cause of this contamination (or when it occurred) is unknown, but it is suspected that a ruptured hydraulic fluid line on a piece of equipment inside the TAN-607 hot shop was the source. During the summer of 1981 the contents of the V-2 tank were cycled through an oil separator to remove the PCBs. By the end of the effort, approximately 225 liters (60 gallons) of oil contaminated with 680 ppm of PCBs were collected. This waste is being stored at TSF pending determination of an appropriate treatment/disposal method. This determination is complicated by radioactive contamination that is also in the waste.

Minor fuel spillage around a gas station is to be expected, but one spill incident at the TSF service station, TAN-664, is worthy of note. In 1981 or 1982 a vehicle entering or leaving the station hooked the pump hose with its bumper and ripped the hose. A calculated 821 liters (217 gallons) of gasoline was spilled around the pump. The fuel was hosed off with water to prevent a fire hazard.

A more serious fuel spill was discovered in 1982 when an underground diesel fuel tank, was found to be leaking. The tank, located just west of the central portion of TAN-607, provided fuel to a standby power generator and to a dispenser. Apparently there was an excavated hole around a portion of the tank in 1982, and water from a heavy rain accumulated in the hole. Perforations in the tank allowed the water to enter and caused about 1900 liters (500 gallons) of diesel fuel to be pushed out the top. The diesel fuel was washed into a storm drainage channel, but more importantly, the tank appeared to have been leaking before the incident. The tank is now abandoned but it is unknown at what rate and for how long it may have been leaking.

There are several general areas of potential contamination at TSF that warrant discussion. The areas include the use of mercury, portable sandblasting that has been accomplished outdoors, and spillage around the V-1, V-2, and V-3 tanks (TAN-742).

Mercury was used extensively at TSF from the early 1950s to the early 1960s. The Heat Transfer Reactor Experiment-3 (HTRE-3), part of the Aircraft Nuclear Propulsion (ANP) Program, used mercury as shielding for its reactor. At one time during the program, a significant portion of the world's supply of mercury was located at TAN. This unit was drained of mercury in 1959-1960, and according to estimates, approximately 100 lbs. could not be accounted for (an estimated 50 lbs. remain in the unit). As might be expected, mercury contamination in waste streams occurred often and spills were referenced in several interviews. One spill of about 4 liters (1 gallon) happened just outside the high bay door of TAN-607. An attempt was made to clean up the spill but an unknown quantity remained on the ground. Spills inside the hot shop area were also noted. Additional spills during use and transportation/storage of the HTRE-3 assembly may have occurred, as described both in this report (see IET, Section 4.4.2.5 and RPSSA, Section 4.2.3.6.2).

Sandblasting has also taken place on the west side of TAN-607. A portable sandblast unit was sometimes taken outside for pieces of equipment too large to take in the sandblast booth. These occasional operations may have produced minimal amounts of waste, but generally the spent media was uncontrolled and it is unknown if any contained toxic metals. However, it should be noted that most sandblasting done in this manner was on structural steel where corrosion was being removed rather than paint. Potentially toxic materials are often of concern when paints are being sandblasted.

In April of 1982 a UOR was filed on a radioactive wastewater leak which occurred while transferring waste from the underground collection tanks (V-2, V-2, and V-3) of the intermediate-level waste disposal system to a tank truck. The UOR stated that the ground around the tanks was already contaminated as characterized in the EG&G Internal Technical Report, "Soil and Tank Radioactivity at the TAN-616 Tank Area," RE-P-80-090, September 1980. These facilities are still being used and the radioactive contamination will be dealt with during deactivation and decommissioning activities.

4.2.3 TAN/TSF Waste Disposal Sites

Areas or sites within the TSF at which hazardous and/or radioactive wastes may have been deposited at some time are discussed in the following paragraphs. A tabular summary of the findings is presented in Table 4.2.3.

4.2.3.1 TSF Disposal Pond (TAN-736).

4.2.3.1.1 Description--Construction of the TSF disposal pond (TAN-736) and common sump in TAN-655 was started in 1971 and completed in late 1972. The pond replaced an injection well (TAN-330) which was used until September 1972.

Low-level radioactive waste, cold process water, and treated sewage effluent are mixed in the common sump and lifted to the disposal pond. The sump pump has a capacity of about 3.0×10^3 L/min (800 gal/min) and is activated when the sump fills up to the float level. The effluent is then pumped to the pond.

The disposal pond is an unlined diked area encompassing approximately 14.2 hectares (35 acres). Taking into consideration volume losses from evaporation and infiltration, the pond's capacity is estimated at 1.25×10^5 m^3/yr (33×10^6 gal/yr). Three trenches were excavated to construct 1.5-m-high earthen dikes around the pond. A 30.5-cm-diameter galvanized steel pipe is the inlet to the pond from the common sump. The inlet pipe extends into the pond about 40 m from the east corner of the pond. A plot plan showing the location of the pond is provided in Figure 4.2.2.

TABLE 4.2.3. TAN/TSF HAZARDOUS WASTE DISPOSAL SITES

Site	Site Name	Period of Operation	Area Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Waste	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problem
TAN-736	TSF Disposal Pond	1972 - present	142,000	Corrosive wastewater Ignitable wastes Chromium Lead	105,000 L 230 L 22 kg Unknown	Discharge to common sump, then to open, unlined seepage pond	Active--Discharge of hazardous, nonradioactive chemicals has been eliminated	Snake River Plain Aquifer is about 63 m from surface which is generally level. Subsurface consists of alternating layers of basalt and silt	Pond is bermed against surface water intrusion	--
TAN-330	TSF Injection Well	1955-1972	N/A	Corrosive wastewater Ignitable wastes Chromium Lead Mercury	725,000 L 320 L 25 kg Unknown Unknown	Discharged with other wastewater directly to deep disposal well with casing reaching to groundwater	Closed--Well capped and sealed	Snake River Plain Aquifer is about 63 m from surface which is generally level. Subsurface consits of alternating layers of basalt and silt	Well head is sealed against surface water intrusion	--
TAN-710A and TAN-710B	Tanks T-709 and T-710 (PM-2A Tanks)	1955-1975	240	Barium Chromium Lead	32.3 kg 27.8 kg 2.4 kg	Discharge to underground tanks located within a concrete cradle	Closed--Free water has been removed from tanks and diatomaceous earth has been blown into remaining sludge	Snake River Plain Aquifer is about 63 m from surface which is generally level. Subsurface consists of alternating layers of basalt and silt	Hatch and pipe entrances are sealed against surface or subsurface drainage intrusion	--
--	TSF Burn Pit	1953-1958	Unknown	Garbage and burnable debris Petroleum products (oil, hydraulic fluid, Stoddard Solvent)	Unknown 5,700 L	Materials where dumped in a pit and burned the same day	Closed, covered and graded	Snake River Plain Aquifer is about 63 m from surface which is generally level. Subsurface consists of alternating layers of basalt and silt	Area is now flat, no special effort has been made to keep out surface drainage	--

TABLE 4.2.3. (Continued)

Site	Site Name	Period of Operation	Area Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Waste	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
--	TSF Gravel Pit	1950s-present	Unknown	Construction rubble Sulfuric acid	Unknown 210 L	Materials where dumped and periodically covered	Active--still receives construction rubble	Snake River Plain Aquifer is about 63 m from surface which is generally level. Subsurface consits of alternating layers of basalt and silt	No special surface drainage diversion structures	--

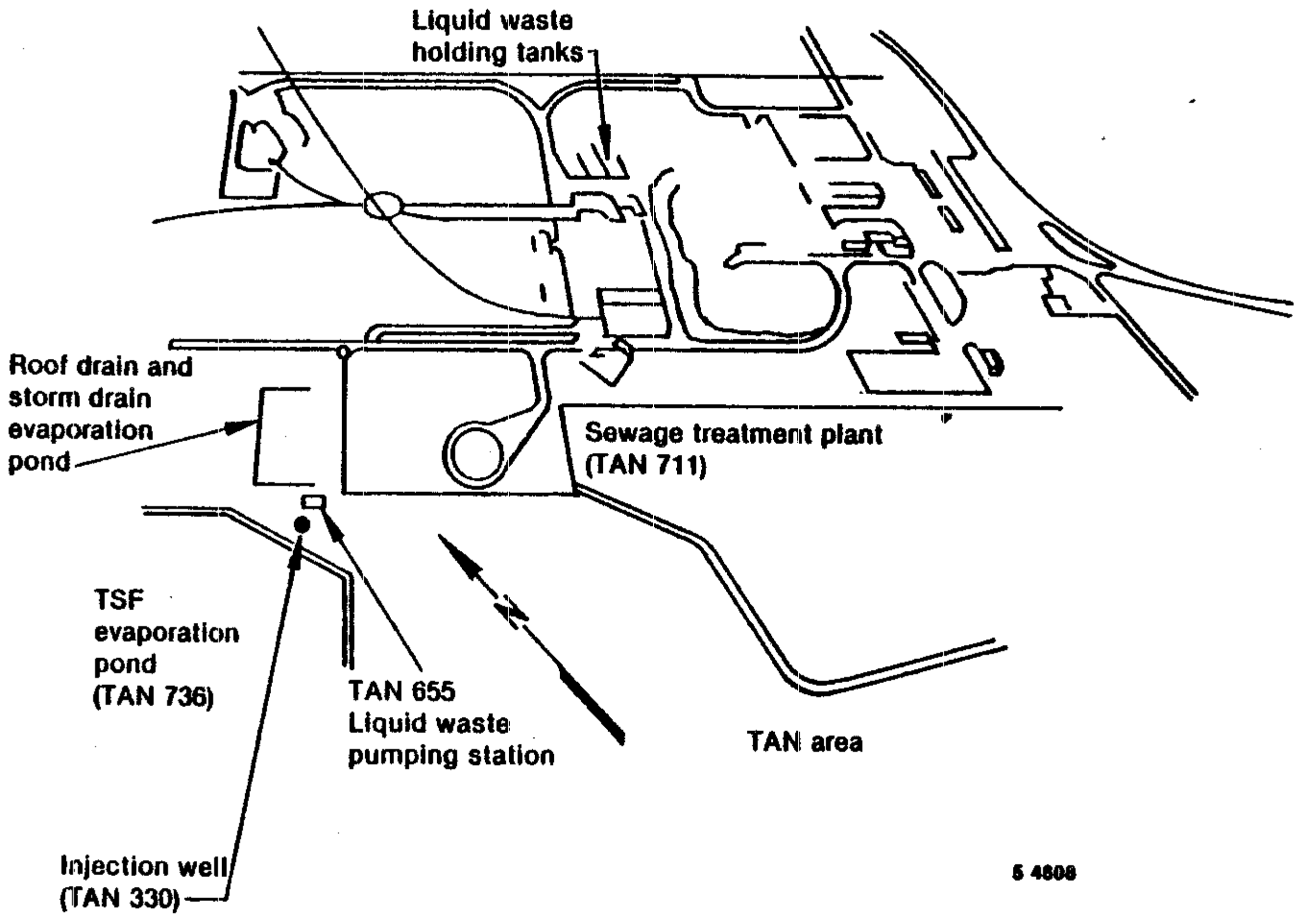

Figure 4.2.2. TAN/TSF Disposal Pond (TAN-736).

4.2.3.1.2 Wastes Received--The TSF disposal pond receives effluent from the TSF trickling filter sewage treatment plant, boiler blowdown from the Service Building (TAN-603), process wastes from the regeneration of water softeners, and lightly radioactive drain waste from the Actuator Building (TAN-615), Hot Cell Annex (TAN-633), and Assembly and Maintenance Building (TAN-607). In addition, lightly radioactive borated wastewater is transported from the LOFT facility to a manhole in the process waste line just upstream of the TAN-655 sump.

The TSF sewage plant (TAN-623) provides primary and secondary treatment for all TSF sanitary wastes and is designed to accommodate a flow of 2.2×10^5 L/d. The plant's influent and effluent are routinely monitored for biochemical oxygen demand, dissolved oxygen, and settleable solids. The effluent is also monitored for pH. The results of these analyses are recorded in the Industrial Waste Management Information System (IWMIS).

The specific hazardous wastes suspected to have reached the TAN-736 disposal pond include corrosive liquids (acidic and basic solutions) from the TAN-607 pipe laundry and photo lab, and small amounts of ignitable waste (paint thinner and solvent) from the maintenance shop. Sampling of the pond influent has shown the wastewater to be noncorrosive according to EPA hazardous waste definitions.

The TSF disposal pond also receives radioactive liquid effluents in which radioactivity is low enough that the liquid can be discharged to a controlled surface pond per DOE Order 5480.1A. Concentrations of these effluents are published monthly in the Radioactive Waste Management Information System (RWMIS) reports. From September of 1972 through July of 1985 the RWMIS reports that over 11 curies have been discharged to the TSF disposal pond. Table 4.2.4 shows the number of released curies by nuclide as of July 31, 1985.

TABLE 4.2.4. CURIES RELEASED TO TSF DISPOSAL POND (BY NUCLIDE) (September 1972 Through July 1985)

Nuclide	Curies Release
Cobalt-58	4.063×10^{-2}
Cobalt-60	1.973×10^{-2}
Cesium-134	2.588×10^{-3}
Cesium-137	2.748×10^{-2}
Hafnium-181	2.046×10^{-3}
Molybdenum-99	1.228×10^{-2}
Ruthenium-106	1.915×10^{-5}
Strontium-89	3.358×10^{-3}
Strontium-90	3.923×10^{-2}
Tritium	1.072×10^{1}
Unidentified alpha	4.566×10^{-3}
Unidentified beta and gamma	2.124×10^{-1}
Yttrium-88	2.757×10^{-4}
Yttrium-90	3.923×10^{-2}
Total	11.124

The TSF disposal pond also received condensate from the evaporator process in the intermediate-level waste disposal system when there was such a process. This system is described further in Section 4.2.3.3. There is no specific information on the chemical characteristics of the evaporator condensate, but if it was similar to the condensate produced at the existing ICPP evaporator, then it can be assumed that it was corrosive (low pH). Table 4.2.1 shows about 24,000 L/yr of corrosive solutions going to the intermediate-level waste disposal system; however, it is unknown how much rinse water was used in addition to this. The TSF Disposal Pond information in Table 4.2.3 assumes 24,000 L/yr of corrosive waste as condensate from the evaporator (through May 1975) and 17,000 L/yr of corrosive waste from the pipe laundry. It is also known that the intermediate-level waste disposal system received an estimated 35 kg/yr of potassium chromate from 1970 through 1974 (see Table 4.2.1), which represents 9.4 kg/yr of chromium. It is not known how much of the chromium passed through the evaporator in condensate and how much stayed as bottoms. The worst case would be for all chromium to have been discharged as condensate to the TSF disposal pond. Discharge to the pond from September 1972 through 1974 would then include approximately 22 kg of chromium. The condensate may also have contained unknown quantities of lead originating from corrosive decontamination solutions being applied to lead shielding.

4.2.3.2 TSF Injection Well (TAN-330).

4.2.3.2.1 Description--The TSF injection well at TAN-330 (N795,400, E357,000) was drilled in 1953 to a depth of 94.5 m (310 feet) to dispose of liquid effluents generated at TSF. It is located just south of TAN-655 shown in Figure 4.2.1. The well has a 40.6-cm diameter (16-inch) casing. Depth to groundwater is 62.8 m (206 feet). The well was last used as a primary disposal site in September 1972 when wastewaters were diverted to the TSF disposal pond (TAN-736). Until the early 1980s the well was used for overflow from the sump at TAN-655, in the event power failure, equipment failure, or equipment maintenance precluded discharge to the pond. There are no records as to whether or not such overflows actually occurred; the well is now capped.

4.2.3.2.2 Wastes Received--The TSF injection well received the same wastewaters which were later received by the TSF disposal pond. The discharges included treated sanitary sewage, process wastewaters, and low-level radioactive waste streams. As with the disposal pond, the hazardous wastes include corrosive and ignitable wastes from shop operations and potentially corrosive and EP Toxic condensate from the intermediate-level waste disposal system evaporator. The EP Toxic heavy metals are suspect because of early (late 1950s and early 1960s) mercury contamination, the use of a potassium chromate solution in decontamination activities after 1970, and the abundance of lead used for shielding materials that were decontaminated with corrosive solutions. The corrosive solutions from the intermediate-level waste disposal system and pipe laundry are estimated at about 24,000 and 17,000 L/yr respectively, but quantities of diluting rinse waters are unknown. The amounts of mercury and lead that may have passed into the evaporator condensate (and to the well) are also unknown. The quantities of chromium can be estimated using the same logic as was presented in the Section 4.2.3.1.2 discussion on wastes received by the TSF disposal pond. As a worst case, the well may have received 9.4 kg/yr of chromium from 1970 through August 1972. This represents approximately 25 kg of chromium.

As mentioned, the TSF injection well also received low-level radioactive waste streams. The RWMIS contains curies by nuclide released to the injection well for 1971 through August 1972. Records of the radioactivity released before 1971 are questionable, but published estimates put the amount released from 1959 through 1970 at about 45 curies. However, no distribution by nuclides is available. Table 4.2.5 shows the nuclide distribution for 1971 and 1972 releases and the calculated distribution for 1959 to 1970 releases assuming the same distribution. Estimated total releases for 1959 through August 1972 are also provided in Table 4.2.5.

TABLE 4.2.5. CURIES RELEASED TO TSF INJECTION WELL (BY NUCLIDE) (1959 through August 1972)

Nuclide	Reported Curies Released (1971 and 1972)	Estimated Curies Released (1959-1970)	Estimated Total Curies Released
Cesium-134	4.597×10^{-3}	2.42×10^{-2}	2.88×10^{-2}
Cesium-137	2.180×10^{-2}	1.15×10^{-1}	1.37×10^{-1}
Strontium-90	8.642×10^{-3}	4.56×10^{-2}	5.42×10^{-2}
Tritium	8.481	44.72	53.20
Unidentified alpha	1.044×10^{-3}	5.51×10^{-3}	6.55×10^{-3}
Unidentified beta and gamma	8.530×10^{-3}	4.50×10^{-2}	5.35×10^{-2}
Yttrium-90	8.642×10^{-3}	4.56×10^{-2}	5.42×10^{-2}
Total	8.534	45	53.53

4.2.3.3 TSF Intermediate-Level Waste Disposal System.

4.2.3.3.1 Description--This radioactive liquid waste system collects, processes, and has interim storage capacity for all intermediate-level radioactive liquid waste generated at the TSF. Drains and sumps, located in areas with a high potential for contamination are piped to a waste transfer facility (TAN-616). Here the radioactive liquid waste is collected in one of three underground 10,000-gallon stainless steel collection tanks (V-1, V-2, or V-3). These tanks are located immediately northeast of TAN-616, between TAN-615 and TAN-633 (see Figure 4.2.1). From this point on, the process for handling these intermediate-level wastes has changed over time. Figure 4.2.3 depicts flow charts for the three different systems that have been used to process this waste.

Originally, liquid waste from the 10,000-gallon collection tanks was concentrated by an evaporator, and the concentrate was transferred to tanks T-709 and T-710 for long-term storage. (T-709 and T-710 are both 50,000-gallon underground tanks, located south of the railroad track turntable and Snake Avenue as shown in Figure 4.2.1.) The condensate from the evaporator was then sent to the TSF injection well (TAN-330).

In 1972, the process was modified so that the original evaporator downstream of the V-1, V-2 and V-3 tanks was removed and a new evaporator installed in the T-709 and T-710 tank area. The intermediate-level waste was then collected in the V-1, V-2, and V-3 tanks and pumped directly to T-709 and T-710, which served as feed tanks for a subsequent stainless steel evaporator. The liquids and entrained radioactive solids were separated in the evaporator; the solids remained in the evaporator vessel which provided interim storage during processing and also served as the long-term storage container. When filled to capacity (about 20 tons), the semisolid radioactive waste was solidified by evaporation, and the container was transferred to the INEL Radioactive Waste Management Complex for disposal. Distillate from the evaporator flowed to the condenser and then to a condensate storage tank. The condensate was passed through a

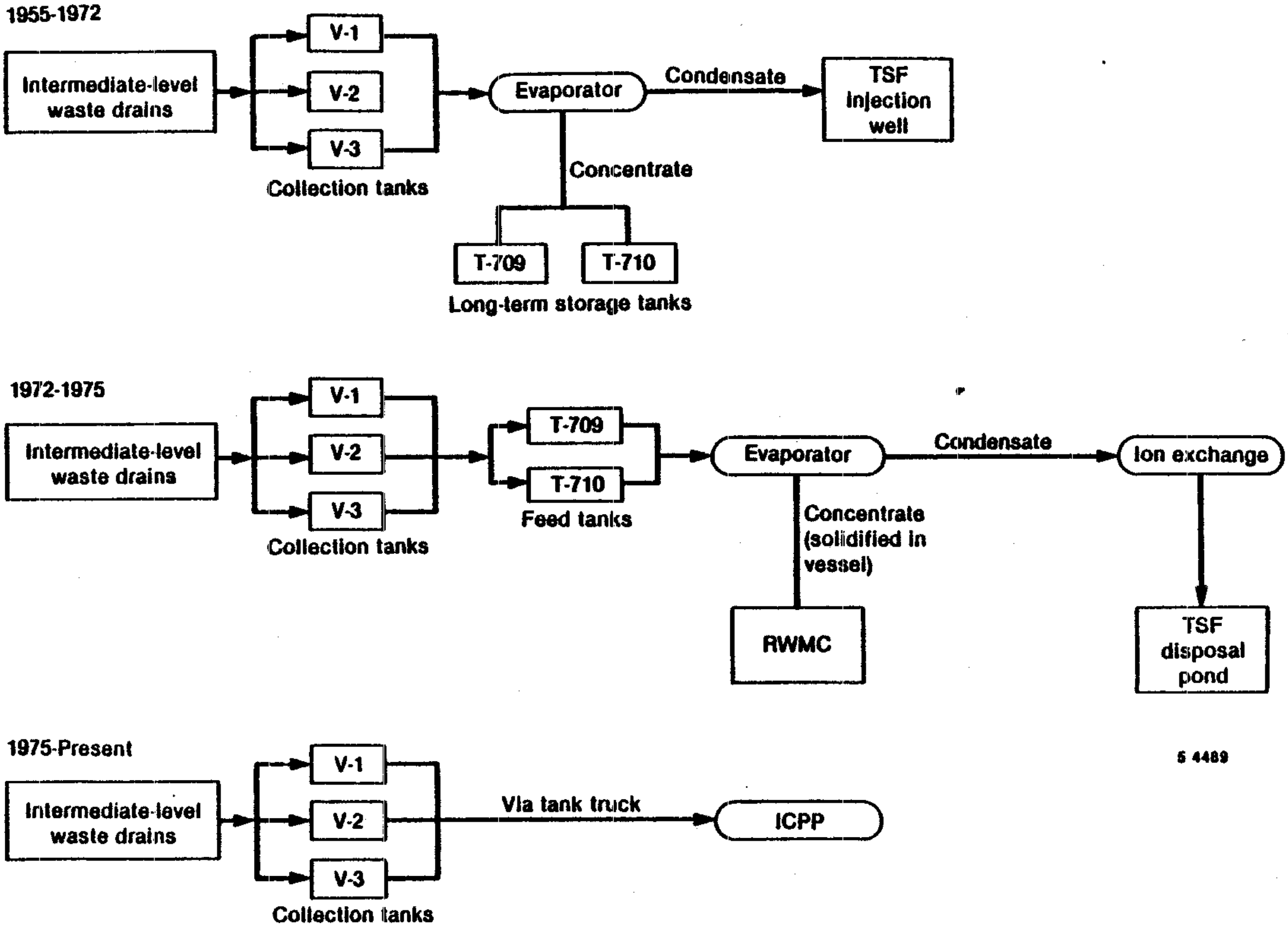

Figure 4.2.3. TSF intermediate-level liquid waste system flow charts.

fabrication ion-exchange column for further removal of radioactive ions. Effluent from the ion exchanger was combined with other TSF low-level radioactive liquid waste prior to discharge into the disposal pond located southwest of the TSF.

The newer evaporator system was shut down in 1975. Because of operational difficulties and spillage, the system was never put into full operation. Since 1975, the TSF intermediate-level waste has been collected in the V-1, V-2, and V-3 tanks and then transferred to tank trucks for shipment to the Idaho Chemical Processing Plant (ICPP).

Tanks T-709 and T-710 rest in separate concrete cradles. These cradles, filled with coarse aggregate and sand, have sufficient void volume to contain leakage even if the tanks were full. An alarm system has been installed in each cradle that allows immediate detection of any leakage.

4.2.3.3.2 Wastes Received--The TSF intermediate-level waste disposal system was designed to receive and treat radioactive waste too warm (radioactively contaminated) to be discharged to a controlled surface pond (TSF-736). Any hazardous chemicals reaching this system were incidental to the processing of radioactive materials. There is definitely the potential that the system received corrosive materials from decontamination activities and, in some instances, heavy metals, particularly mercury during its extensive usage in the late 50s and early 60s. Also, it is known that small quantities of potassium chromate were used in decontamination solutions from 1970 to 1974.

Records are unavailable to show what hazardous chemicals may have passed through the evaporator (when it was in use) and into the condensate stream. However, estimates were made in the preceding discussions of disposal sites receiving the condensate. It can also be assumed that the concentrate from the evaporator system may have contained small quantities of hazardous chemicals but these concentrates were eventually solidified before disposal at the RWMC. The chemicals with the hazardous characteristics identified should pose little problem in a solidified form.

From 1955 to 1975 the majority of the radioactive material discharged to this system was eventually disposed of at the RWMC. The lesser amounts of radioactivity that were discharged in the condensate to either the disposal pond or well were included in the quantities discussed in those earlier sections (see Tables 4.2.3 and 4.2.4, respectively). Since mid-1975 all wastewater reaching this system has been trucked to the ICPP for processing and is not a concern for this location.

4.2.3.3.3 Current Status--There has been significant radioactive contamination around the major components of the intermediate-level waste disposal system. The V-1, V-2, and V-3 tanks are still in use but have surface contamination in the area above them. This was briefly discussed in Section 4.2.2.3. The evaporator equipment has been removed and buried at the RWMC, and the T-709 and T-710 tank area has gone through the decontamination and decommissioning (D&D) process. However, the tanks themselves are still in place.

At different times the T-709 and T-710 tanks received concentrate from the evaporator and unprocessed wastewater. Since the tanks were last used in 1975, their contents have been pumped twice, both times with the waste being solidified and taken to the RWMC for burial. Leaking occurred during the first solidification action and resulted in significant surface contamination around the tank area. The second solidification action in 1981 was part of the D&D process which later included removal of soil from the highly contaminated areas for burial at the RWMC. After backfilling the area with radiologically clean soil, surface activity is negligible.

During the D&D process it was decided to leave the T-709 and T-710 tanks in place, at least until the entire TAN area is decommission. This decision was due partly to the concern that the 30-year-old tanks may no longer be strong enough to with stand the strain of being lifted out of place. Also the tanks still contained contamination sludge which could not be pumped out but which could leak out in the event of a tank rupture. It was also decided to dry the sludge out by adding diatomaceous earth, another precaution against leakage from the tanks.

The sludges in both tanks have been sampled and characterized. The results of 1981 chemical analyses are provided in Table 4.2.6. These results are based on a single grab sample and the sludge may not be homogeneous. However the sample does give an idea of the contents of the sludge and shows that barium, chromium, and lead (all toxic metals) are present. If homogeneity is assumed, Tank 709 could contain about 0.7 kg of barium, 2.5 kg of chromium, and 0.2 kg of lead; Tank 710 could contain about 31.6 kg of barium, 25.3 kg of chromium, and 2.2 kg of lead.

The 1981 sludge samples were also analyzed for radionuclides. The results of that sampling are provided in Table 4.2.7, along with the total curies in the tanks as of 1981. Again, it should be noted that the figures for total curies are based upon a homogeneous sludge which may not actually be the case. However, it does allow an estimate of the activity in the tanks.

4.2.3.4 TSF Burn Pit.

4.2.3.4.1 Description--The TSF burn pit was used for open burning of combustible waste from about 1953 to 1958. It was located north of the TAN/TSF water tank (TAN-701) just outside the TSF fence, as shown in Figure 4.2.4. The site is now covered-in and natural vegetation has been reestablished. The use of this pit was discontinued when a similar operation was started at WRRTF, a little more than a mile to the southeast.

4.2.3.4.2 Wastes Received--The pit took all garbage and burnable debris from the TAN area. It is suspected that the pit also received some oils and solvent (Stoddard Solvent) from the limited auto maintenance activities at TSF. From Table 4.2.1, the volume of these petroleum products could have been as high as 950 L/yr. The normal operating practice at the pit was to burn every time materials were dumped. Therefore, it is also suspected that a significant portion of petroleum products deposited there were destroyed. It is possible that small quantities of other hazardous materials may have reached this pit, but there are no records and it is likely that they would also have been destroyed.

TABLE 4.2.6. CHEMICAL ANALYSIS OF SLUDGE IN TSF TANKS T-709 AND T-710

Parameter	Results	
	T-709 Sludge	T-710 Sludge
Volume (L)	1374	7033
Undissolved solids conc. (g/L)	262	448
Al (g/L)	5.2	3.6
Ba (g/L)	0.5	4.5
Ca (g/L)	5.2	9.0
Cr (g/L)	1.8	3.6
Cu (g/L)	0.005	0.013
Fe (g/L)	15.7	17.9
Mg (g/L)	2.6	4.5
Mn (g/L)	1.8	2.2
Ni (g/L)	0.03	0.09
Pb (g/L)	0.16	0.31
Si (g/L)	86.5	85.1
Sn (g/L)	0.13	0.04
Ti (g/L)	0.08	0.13
Zn (g/L)	0.79	0.90
Zr (g/L)	0.03	0.04
P (g/L)	7.9	49.3

TABLE 4.2.7. CURIES CONTAINED IN TANK T-709 AND T-710 SLUDGES (as of 1981 sampling)

	Tank T-709		Tank T-710		
Radionuclide	Concentration (Ci/L)	Total Curies	Concentration (Ci/L)	Total Curies	Total Curies Both Tanks
(Am) Americium	1.12×10^{-7}	1.54×10^{-4}	8.14×10^{-7}	5.72×10^{-3}	5.88×10^{-3}
(Co) Cobalt-60	3.05×10^{-4}	4.19×10^{-1}	9.70×10^{-5}	6.82×10^{-1}	1.10×10^{0}
(Cs) Cesium-134	5.87×10^{-6}	8.07×10^{-3}	2.10×10^{-6}	1.48×10^{-2}	2.29×10^{-2}
(Cs) Cesium-137	3.37×10^{-3}	4.63×10^{0}	--	--	4.63×10^{0}
(Eu) Europium-154	1.36×10^{-5}	1.87×10^{-2}	--	--	1.87×10^{-2}
(Np) Neptunium-237	1.18×10^{-4}	1.62×10^{-1}	1.08×10^{-4}	7.60×10^{-1}	9.22×10^{-1}
(Sr) Strontium-total	2.65×10^{-3}	3.64×10^{0}	4.27×10^{-3}	3.00×10^{1}	3.36×10^{1}
(Pu) Plutonium	2.17×10^{-6}	2.98×10^{-3}	2.00×10^{-6}	1.41×10^{-2}	1.71×10^{-2}
Totals		8.88×10^{0}		3.15×10^{1}	4.03×10^{1}

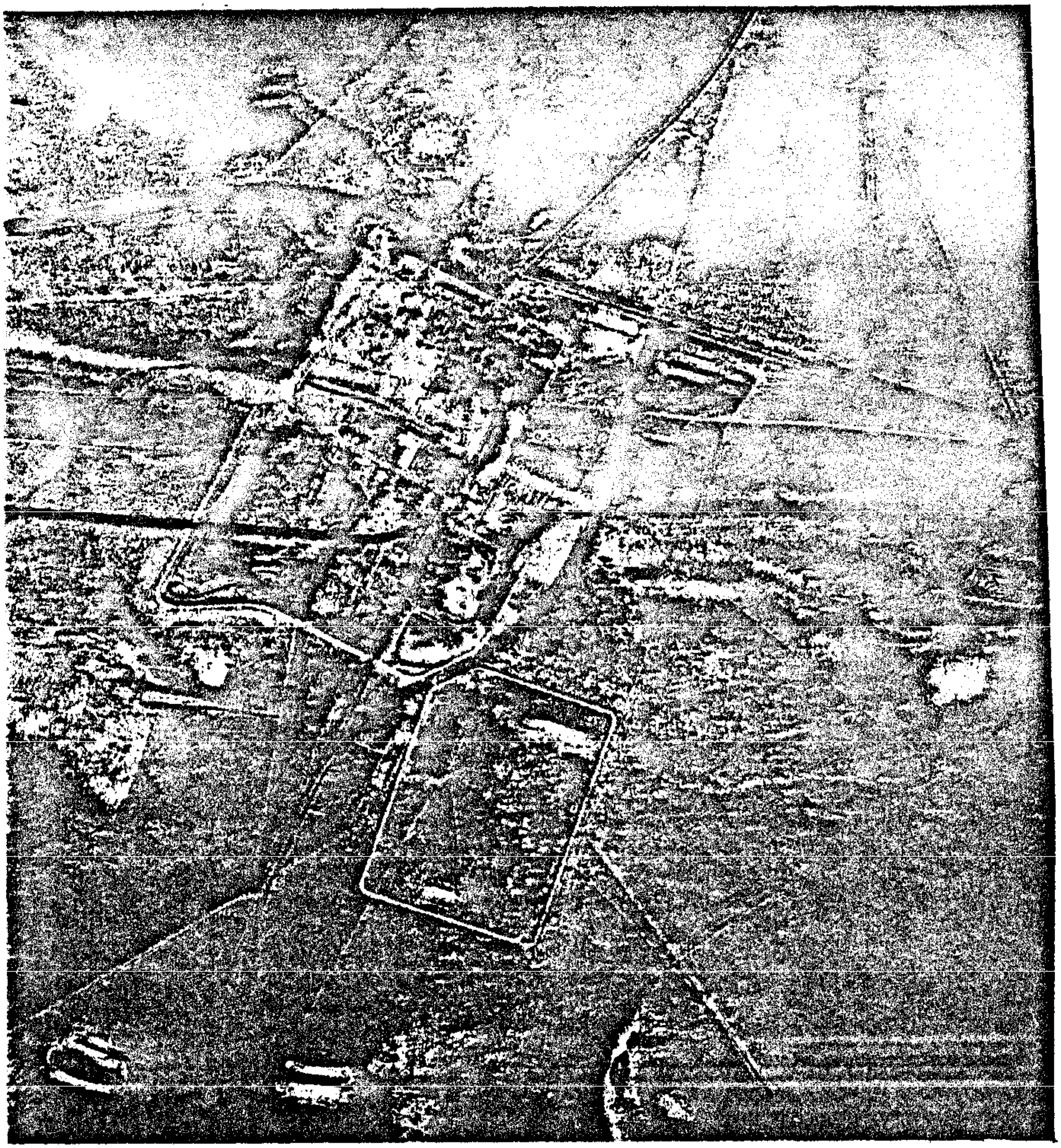

Figure 4.2.4. TAN/TSF burn pit.

4.2.3.5 TAN Gravel Pit.

4.2.3.5.1 Description--Since the early 1950s when construction began at the TAN area, gravel/fill material has been brought in from nearby areas. One such excavation site is located approximately 1-1/2 miles northwest of the TAN/TSF area. Over the years it has also been the practice to dump construction rubble (i.e., concrete, asphalt, etc) in this area. The rubble is periodically covered. The last cover was put on about 4 or 5 years ago but more rubble has accumulated since then.

4.2.3.5.2 Wastes Received--There have been at least two relatively minor incidents where waste other than construction rubble was deposited at this site. Section 4.2.2.3 described an event where a 55-gallon drum (208 liters) of sulfuric acid was drained into this pit. Section 4.3.2.3 describes a spill from which an unspecified quantity of soil contaminated with sulfuric acid was also taken. There was no other evidence found that would indicate the presence of additional hazardous materials.

4.2.3.6 Radioactive Parts Security and Storage Area (RPSSA)/TSF-1 Area.

4.2.3.6.1 Description--The RPSSA/TSF-1 areas are located northwest of TAN-607 as shown in Figure 4.2.5. The TSF-1 area is that area east of the tracks going to IET and the RPSSA includes the storage pads around Buildings TAN-647 and TAN-648. This combined area has been, and still is, utilized as a common storage site for radioactively contaminated equipment. Significant contamination remains even in those open field areas where equipment is no longer stored.

4.2.3.6.2 Wastes Received--The surface area of the TSF-1 has been characterized by EG&G D&D activities. However, it is known that spent ion-exchange resins (used to remove radionuclides from storage pool water) and two irradiated core storage structures (without cores) were buried just

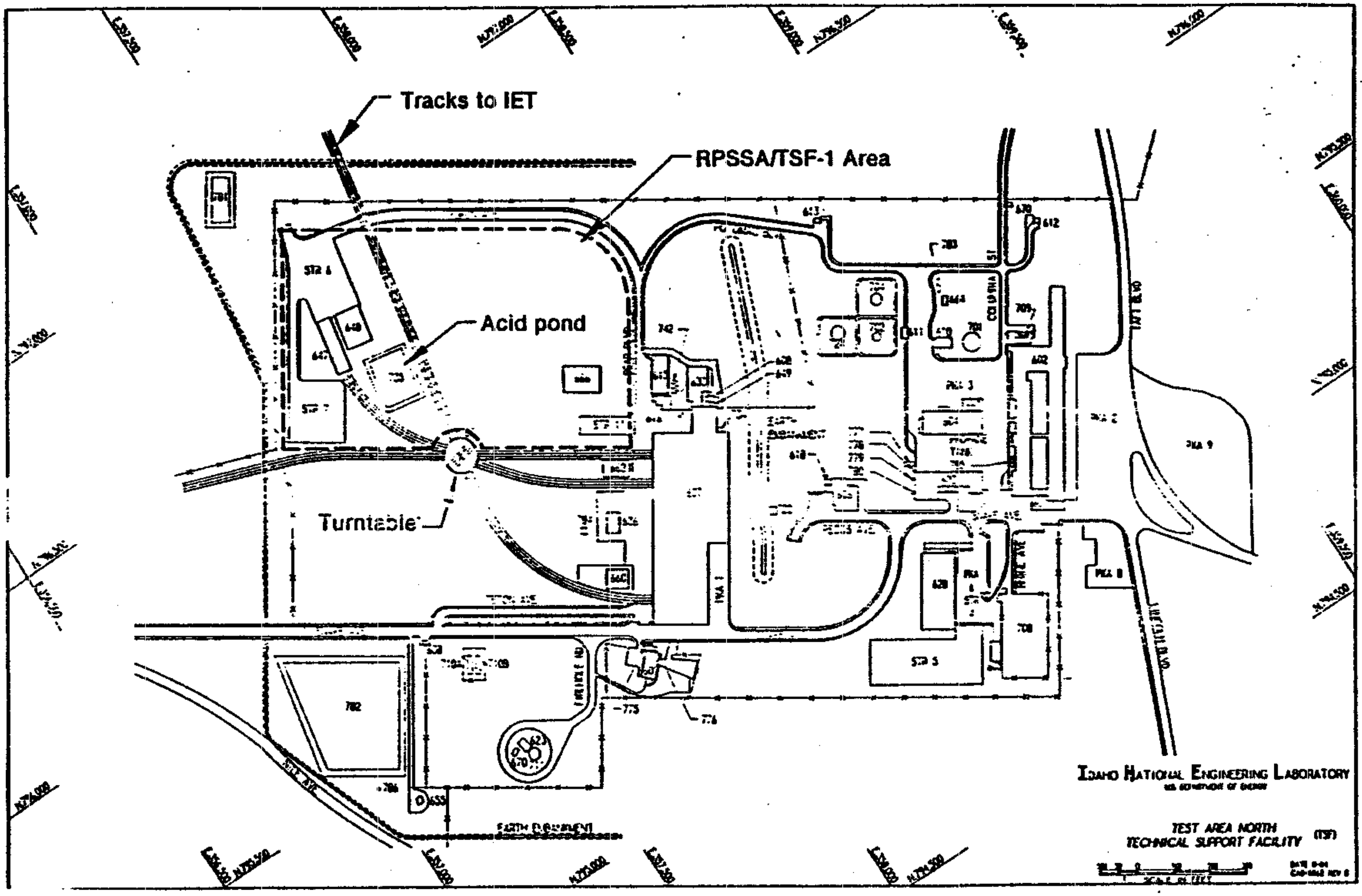

Figure 4.2.5. Location of Radioactive Parts Security and Storage Area (RPSSA)/TSF-1 Area.

northwest of the turntable. It is suspected that there may be other materials buried in the general area. The total number of curies of radioactive materials in or on the ground in this area is unknown, but D&D has characterized the surface by using a sampling grid program.

The paved storage areas of the RPSSA are still the location of significant quantities of contaminated equipment. Surface contamination of the asphalt pads is widespread due to radioactive materials falling or washing off of the contaminated equipment. In one instance, an irradiated core cask was left open to the environment and precipitation washed through the cask, draining onto the pad. This same cask broke through the asphalt pad and contaminated water probably went through the pad at that point. Other contamination is suspected to be limited to surface areas. In this same area is an evacuated area designated as TAN-735 on Figure 4.2.6. This depression, referred to as the acid pond, did not receive hazardous chemicals, but it did receive contaminated runoff from the RPSSA/TSF-1 areas and has been used as a dumping area for radioactively contaminated soils. One primary ditch entering this pond extends to the east all the way across the TSF-1 area to the TAN-615/616/633 area. This area of buildings is where the radioactive wastewater has historically been treated or transferred to tank trucks. Spillage or overflow from this operation would have gone to this ditch.

Recently (early 1986) mercury contamination has been reported on the ground near the old HTRE-3 motor, (and on the HTRE-3 itself) which is stored just northwest of TAN-607. The extent of contamination has not yet been determined but approximately 13 lbs. of mercury were recovered from the area immediately surrounding the unit in 1986. It is possible that contamination extends to approximately one mile of railroad tracks, over which the unit was transported (between TAN/TSF and TAN/IET).

The entire RPSSA/TSF-1 area is in the D&D Long Range Program for characterization and cleanup. As mentioned earlier, some of the characterization has already been accomplished, more is planned for the future.

4.3 TAN/LOFT Past Activity Review

4.3.1 TAN/LOFT Description

The Test Area North (TAN)/Loss of Fluid Test (LOFT) area is located in the north central portion of INEL, as was shown in Figure 3.3. The area includes the LOFT Containment and Service Building (reactor facility), an aircraft hangar from the defunct ANP Program, the LOFT reactor Control and Equipment Building, and numerous support facilities. A four-rail railroad track connects the area to the TSF 2.4 km to the east. Figure 4.3.1 is a plot plan of the LOFT area.

The LOFT reactor is part of the Mobile Test Assembly (MTA), mounted on a specially designed railroad flatcar located inside the domed Containment Vessel. Systems for operating and monitoring the reactor are located inside structures immediately adjacent to the Containment Vessel.

Construction of the LOFT facility was basically completed by the end of 1973, and the experimental program began the latter part of 1974. The LOFT facility is used to perform loss-of-coolant experiments (LOCE) as part of the nation's power water reactor safety program.

4.3.2 TAN/LOFT Wastes Generated by Activity

4.3.2.1 LOFT Reactor/Utility Operations (Shops, Labs, and Processes). The LOFT areas identified in Table B.1 of Appendix B were investigated for possible production of hazardous wastes. Those pertinent to this report are identified in Table 4.3.1 and are discussed in the following paragraphs.

The Craft Workshop in TAN-624 used small quantities of hazardous materials, but, according to the best recollection of workers at LOFT, there were no hazardous wastes generated. The shop was used for parts/component fabrication. The small quantities of materials, such as solvents (specifically acetone) used for parts cleaning and acid fluxes used in welding, were consumed in the operation. The building has no floor drains.

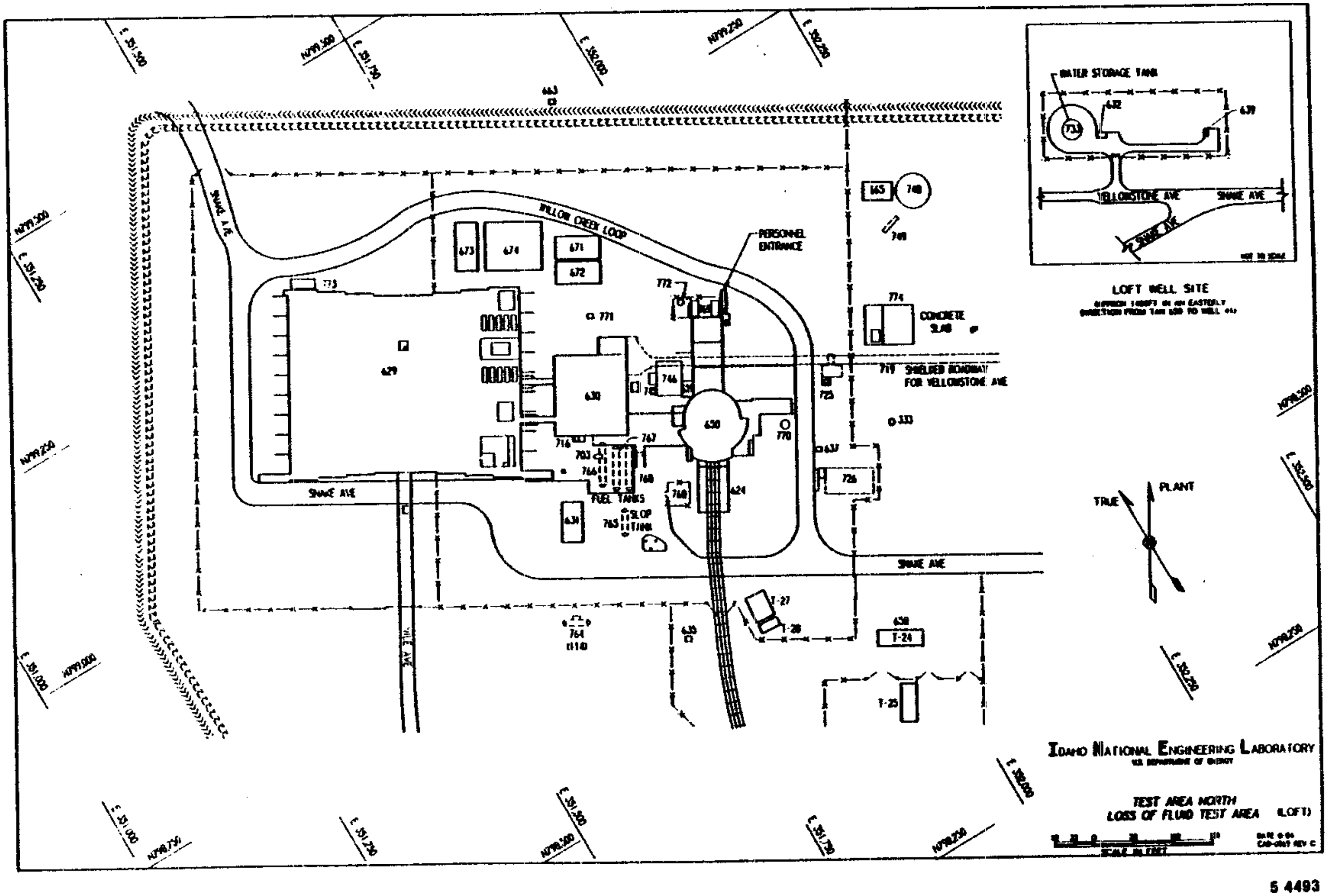

Figure 4.3.1 Test Area North/Loss-Of-Fluid Test (TAN/LOFT plot plan).

TABLE 4.3.1. LOFT WASTE GENERATION

Shop Location	Function	Waste Stream	Time Frame	Estimated Quantities (if known)	Treatment/Storage/Disposal
TAN-630	Chemical laboratory	Toluene (mixed with fuel oil)	1973-present	1 Liter/yr	Burned in area boilers
		Carbon tetrachloride	1982-1984 1982-1984	500 mL Total 500 mL	TSF Disposal Pond Solidified; to RWMC
		Acid	1973-present	Minimal	LOFT pond (TAN-750)
TAN-630	Demineralization plant	Sulfuric acid (ion exchange regenerant)	1973-1984	2,350 kg/yr	LOFT pond (at least partially neutralized)
		Sodium hydroxide (ion exchange regenerant)	1973-1984	5,930 kg/yr	LOFT pond (at least partially neutralized)
Various Locations	Waste oils/solvent management	Mixture of lubricating oil, hydraulic fluid, stoddard solvent and methylene chloride	1973-1984	38 Liter/yr	Burned in boilers
			1984-Present	35 Liters/yr	Oil recycling or off-site disposal as hazardous waste

The Craft Shop in TAN-25 was also used for the fabrication of such items as pipings and fittings. Again, the facility may have used small quantities of hazardous materials, but there is no evidence that significant hazardous wastes were generated. The building has no water service or floor drains.

The small chemical laboratory in TAN-630 produced minor quantities of toluene, carbon tetrachloride, and acid. Toluene is used in routine fuel oil analyses which generates a waste mixture that consists of about 50 mL of toluene per liter of fuel oil. It is estimated that a maximum of one liter of toluene per year is used in this manner. The toluene/fuel oil mixture is put back into the feedstock for the area boilers. Carbon tetrachloride was discharged to the TSF pond and the RWMC from 1982-1984. The total amount discharged to the pond was approximately 500 mL. Approximately the same amount was solidified, compacted, and sent to the RWMC. All of the carbon tetrachloride was contaminated with short-lived isotopes of radioactive iodine and fission gases. Waste acid, also generated in extremely small quantities, goes down drains that lead to the LOFT pond.

The demineralization plant pumps acidic and basic regenerant solutions to the LOFT pond. It is estimated that 2350 kg of sulfuric acid and 5930 kg of sodium hydroxide are used each year and eventually make their way to the pond. However, the operation at LOFT is arranged so that both cation- and anion-column regenerants are drained to the same 700-gallon sump prior to discharge to the pond. In 1984 a series of samples of the sump discharge were taken for a short period of time. The timeframe of sampling was felt to represent normal operating conditions during regeneration. Although the discharge was alkaline, the pH never rose above 11.2. This sampling cannot be considered conclusive, but it is likely that much of the ion-exchange regeneration solutions did not meet the definition of corrosive hazardous wastes as they were discharged to the LOFT pond. Also the LOFT pond receives significant amounts of water from other sources and should have always provided neutralization of these regenerates through dilution. Current operations have been modified so that increased quantities of sulfuric acid are used during regeneration to ensure that discharges from the 700-gallon sump are always nonhazardous.

4.3.2.2 LOFT Fuels/Petroleum Management. Bulk fuels used at LOFT are limited to No. 2 fuel oil and diesel oil. Two 35,000-gallon underground storage tanks provide working supplies for the fuel oil used in boilers and one 50,000-gallon tank provides storage for the diesel oil used for standby power generators. Both the materials are delivered to the underground tanks by tank truck. Table 4.3.2 provides an inventory of the fuel/petroleum storage tanks at LOFT.

Various activities at LOFT occasionally generate small quantities of waste lubricating oil, hydraulic fluid and solvent (specifically Stoddard Solvent and methylene chloride). In the past, these materials were accumulated in a single drum which was periodically pumped by the Site fire department. The pumped material was then blended with fuel oil and burned in boilers. It is estimated that as much as 38 liters (10 gallons) of these materials were collected and treated in this manner each year. This information was included in Table 4.3.1. The current practice is to collect the liquids in separate containers for ultimate recycling or disposal as hazardous waste.

4.3.2.3 Spills Within the LOFT Area. Personnel interviews, site observations, and review of UORs, were used to obtain information on the spills identified in this section.

In the February-March timeframe of 1982, an estimated 5,000 gallons of diesel fuel was spilled outside the large hangar building, TAN-629. The spill was caused by overflowing the diesel generator day tank. The diesel fuel, which was lost over at least a one-week period, was discharged through a drain pipe to an outside ditch. The ditch is located on the northeast side of TAN-629 and extends in a northeasterly direction to a culvert that carries it beneath Willow Creek Loop as shown in Figure 4.3.1. The fuel had nowhere to go but into the soil along the small ditch.

Another spill occurred in May of 1983 on the northeast side of TAN-629 at the sulfuric acid tank. This aboveground storage tank and its concrete containment pad are identified as Building TAN-771 on the plot plan in

TABLE 4.3.2. LOFT-FUEL/PETROLEUM STORAGE TANKS

TAN-630 (LOFT) (Room 133)	Diesel No. 2	400	U, I	Automatic gauge on pump line	--	LOFT facility	Filled by line from underground tank
TAN-630 (LOFT)	No. 2 fuel oil	35,000	U, O	Dipstick	OIBFW650	LOFT facility	2 tanks
TAN-630 (LOFT)	Diesel No. 2	50,000	U, O	Dipstick	OIBFW618	LOFT facility	--
TAN-665 (LOFT)	Diesel No. 2	300	A, I	Dipstick	--	LOFT facility	No curbing
LOFT	Diesel No. 2	500	U, O	Automatic guage on pump line	--	LOFT facility	On east side of hangar filled by line from underground tank
LOFT	Diesel waste	--	U, O	--	--	--	Abandoned; under parking lot

Figure 4.3.1. An estimated 260 gallons of sulfuric acid spilled into the concrete basin from a leaking piping connection. Most of the acid, 240 gallons, was pumped into drums. The drums were then taken to the LOFT pond and drained. The 20 gallons remaining in the pit were neutralized with sodium hydroxide and sodium carbonate. Once the containment basin had been cleaned, soil samples were taken around the basin to see if any acid had escaped. A low pH was detected in an area just outside the west side of the basin. The acidic soil was excavated and taken to a pit north of the LOFT area. Further checks revealed no other contamination in the surrounding soil.

In October of 1984 the diesel generator day tank overflowed again. An estimated 400 to 530 gallons of diesel fuel were lost to the same drain and ditch as described in the 1982 spill. A visual inspection of the outside ditch in April of 1985 showed an oily stain in the ditch but no other obvious sign of spills.

4.3.3 TAN/LOFT Waste Disposal Sites

Figure 4.3.2 provides a schematic of the liquid-waste systems at LOFT; the waste trucked to the TSF pond was discussed in Section 4.2.3.1. Areas or sites within the LOFT facility at which hazardous or radioactive wastes may have been deposited at some time are discussed in the following paragraphs and are summarized in Table 4.3.3.

4.3.3.1 LOFT Disposal Pond (TAN-750).

4.3.3.1.1 Description--The LOFT pond was constructed in 1971 and was designed as a seepage pond. Figure 4.3.3 shows the relative location of the pond. It was excavated by enlarging the natural contour of an inactive borrow pit. The thickness of surface sedimentary material of the pond area is approximately 7.6 to 10.7 m (25 to 35 ft). The pond floor dimensions are approximately 152 m (500 ft) long by 76 m (250 ft) wide by 5.5 m (18 ft) deep; the sides are on a 2:1 slope. The regional groundwater level is about 61 m (200 ft) below the surface. A 0.6-m (2-ft) high and

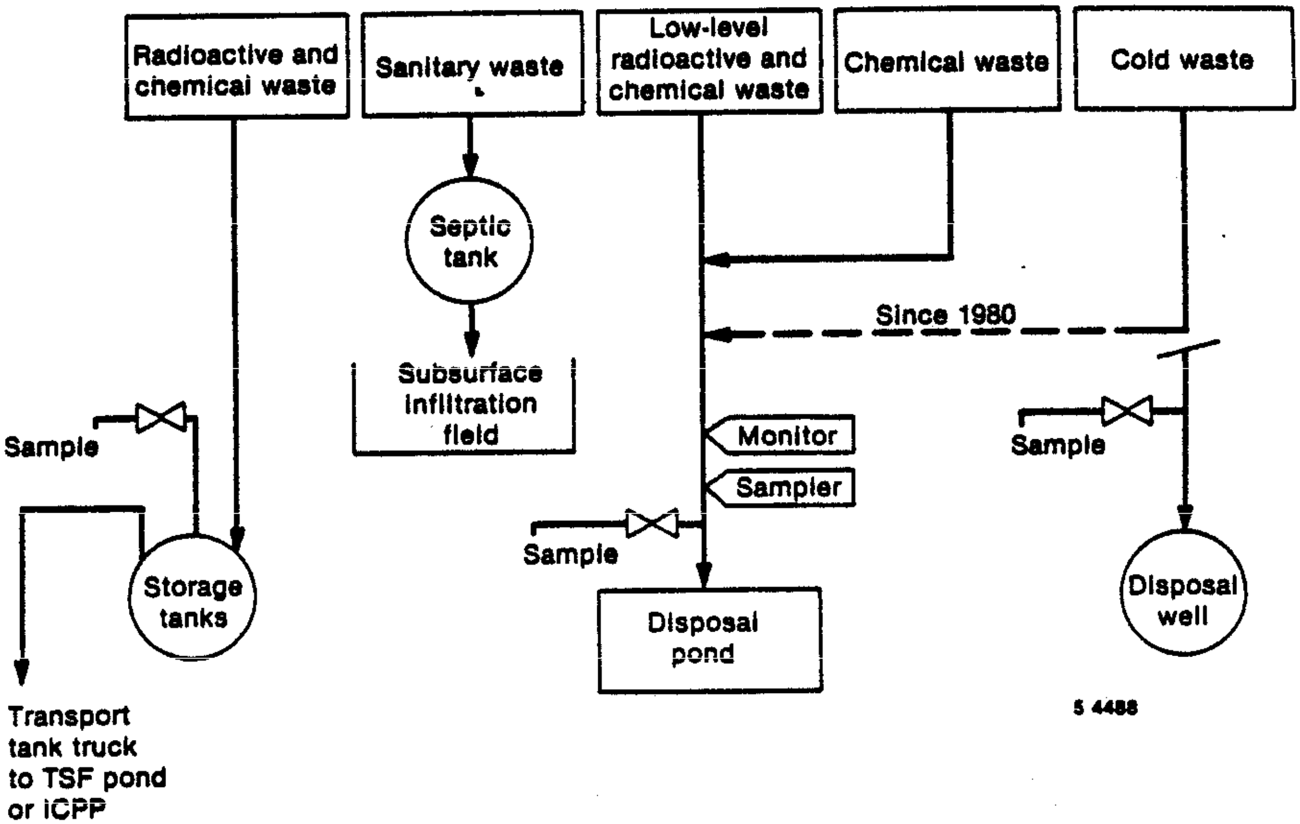

Figure 4.3.2 Schematic of the LOFT liquid waste systems.

TABLE 4.3.3. TAN/LOFT HAZARDOUS WASTE DISPOSAL SITES

Site	Site Name	Period of Operation	Area Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Waste	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
TAN-750	LOFT Disposal Pond	1971 - present	11,500	Sulfuric acid[a] Sodium hydorxide[a]	28,200 Kg 71,200 Kg	Sulfuric acid and sodium hydroxide from the demineralization plant were discharged to a common sump before going to the pond.	Active--discharge of hazardous, non-radioactive chemicals has been eliminated.	Snake River Plain Aquifer underlines the site at a depth of about 61 M. Surface is generally level. Subsurface consists of alternating layers of basalt and silt.	The pond is surrounded by an earthern berm which prevents surface runoff from entering.	None
TAN-333	LOFT Injection Well	1971 - 1980	NA	NO hazardous materials are suspected.	NA	Cooling water drained to a common sump which drained to the well.	Closed--well capped and sealed.	Same	Well head is sealed against surface water intrusion.	None

a. These materials (acids and bases) were at least partially neutralized before being discharged to the pond.

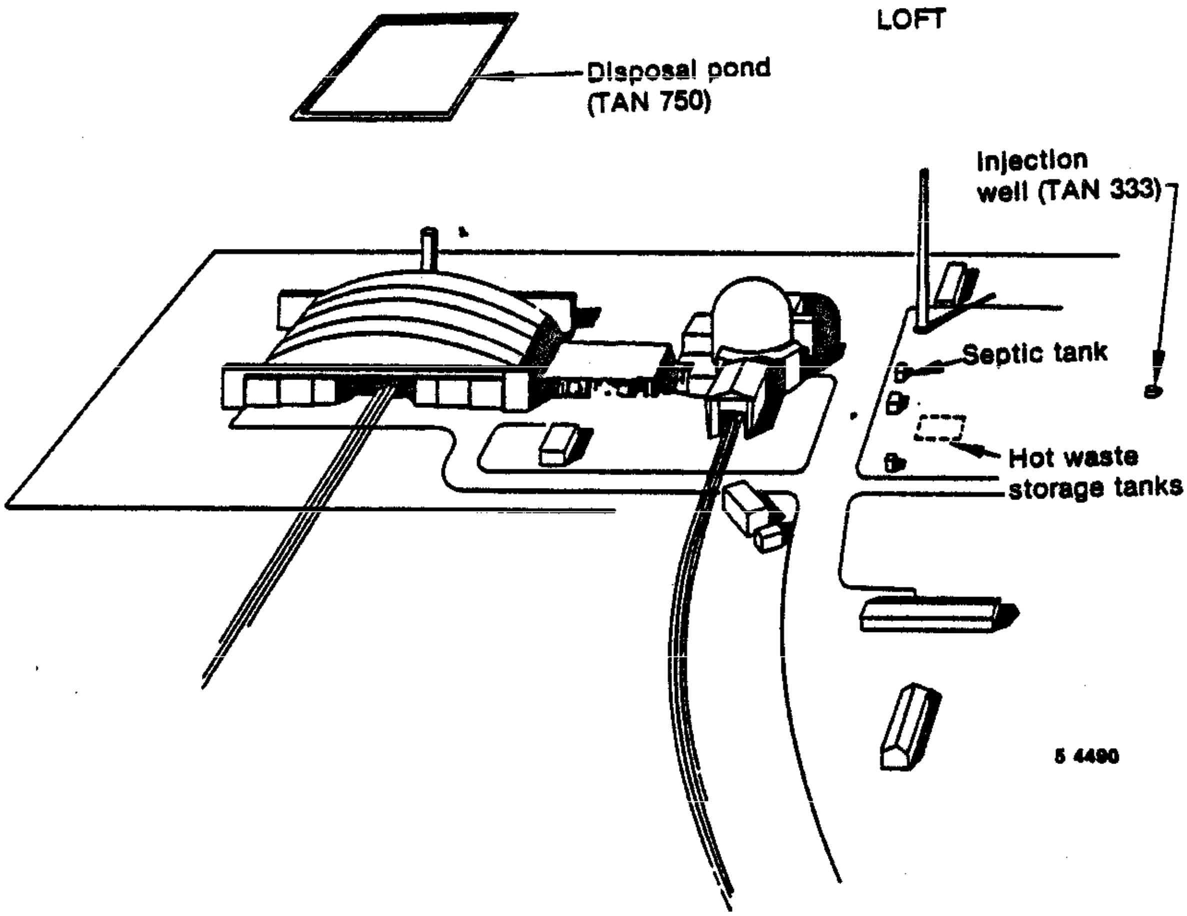

Figure 4.3.3 Location of LOFT Disposal Pond and Injection Well.

3.7-m (12-ft) wide (top width) earthen berm encloses the pond to prevent surface runoff from entering. The usable capacity of the pond is estimated at 68 x 10^6 L (18 x 10^6 gal).

4.3.3.1.2 Wastes Received--The LOFT seepage pond was designed to dispose of low-level radioactive and chemical liquid wastes which do not exceed concentration limits for uncontrolled surface pond disposal per DOE Order 5480.1A. The major sources of low-level radioactive wastes include:

- Primary component heat exchanger cooling water
- Low-pressure injection system pump cooling water
- Personnel change room showers
- Miscellaneous floor drains and cooling water from small heat exchangers.

The quantities of low-level radioactive wastewater sent to the LOFT disposal pond have been measured and recorded in the RWMIS reports. Table 4.3.4 provides the summary of radionuclides that have been discharged to the pond from April 1978, when the first low-level waste was discharged, through July 1985. The second column in Table 4.3.4 provides the "less-than-detectable" curies, assuming that they fit the same distribution of know radionuclides as shown in the first column. The third column shows the total curies released, assuming the second column breakdown. (This is done for scoring purposes which is discussed in later sections.)

Nonradioactive process water wastes include boiler blowdown, and wastes from regeneration of demineralizer beds and water softeners. The major sources and contents of liquid chemical wastes are:

- NaCl from water softening

TABLE 4.3.4. CURIES RELEASED TO LOFT DISPOSAL POND (April 1978 through July 1985)

Nuclide	Reported Curies Released	Assumed Distribution of Less-Than-Detectable Curies	Estimated Total Curies Released
Cerium (Ce-141)	8.800×10^{-5}	7.05×10^{-4}	7.93×10^{-4}
Cesium (Cs-137)	1.442×10^{-2}	1.16×10^{-1}	1.30×10^{-1}
Chromium (Cr-151)	7.087×10^{-4}	5.68×10^{-3}	6.39×10^{-3}
Cobalt (Co-57)	5.025×10^{-5}	4.03×10^{-4}	4.53×10^{-4}
(Co-58)	9.959×10^{-4}	7.98×10^{-3}	8.98×10^{-3}
(Co-60)	1.282×10^{-2}	1.03×10^{-1}	1.16×10^{-1}
Europium (Eu-152)	3.071×10^{-6}	2.46×10^{-5}	2.77×10^{-5}
Gold (Au-198)	1.254×10^{-4}	1.00×10^{-3}	1.13×10^{-3}
Molybdenum (Mo-99)	8.176×10^{-5}	6.55×10^{-4}	7.37×10^{-4}
Niobium (Nb-97)	4.408×10^{-3}	3.53×10^{-2}	3.97×10^{-2}
Silver (Ag-110)	5.567×10^{-4}	4.46×10^{-3}	5.02×10^{-3}
Strontium (Sr-85)	6.859×10^{-6}	5.50×10^{-5}	6.19×10^{-5}
(Sr-89)	2.754×10^{-3}	2.21×10^{-2}	2.49×10^{-2}
(Sr-90)	8.804×10^{-4}	7.05×10^{-3}	7.93×10^{-3}
(Sr-92)	9.675×10^{-4}	7.75×10^{-3}	8.72×10^{-3}
Technetium (Tc-99M)	3.913×10^{-4}	3.14×10^{-3}	3.53×10^{-3}
Unidentified alpha	9.396×10^{-4}	7.53×10^{-3}	8.47×10^{-3}
Unidentified beta and gamma	8.709×10^{-3}	6.98×10^{-2}	7.83×10^{-2}
Less-than-detectable	3.921×10^{-1}	--	--
Total	4.411×10^{-1}	3.92×10^{-1}	4.41×10^{-1}

- NaOH and H_2SO_4 from demineralization

- Na_2SO_3, Na_3HPO_4 and Na_2PO_4 from corrosion and scaling control.

Small quantities of laboratory chemicals have also found their way to the LOFT disposal pond. Estimates of the minor quantities from this source as well as from the major sources identified above are provided in Table 4.3.3.

4.3.3.2 LOFT Injection Well (TAN-333).

4.3.3.2.1 Description--The 25.4-cm (10-in.) diameter, 91.4-m (300-ft) deep injection well was drilled at LOFT in 1957. The well is located south east of the LOFT site, as depicted in Figure 4.3.3. The well sump is 1.2 m (4 ft) in diameter and 2.1 m (7 ft) deep, sloping to a 0.6-m (2-ft) diameter manhole. Maximum capacity of the well is about 5700 L/min (1500 gal/min). Since 1980, piping to the well has been removed and the well itself has been sealed with a welded cap.

4.3.3.2.2 Wastes Received--During LOFT operations the well was used for disposal of cooling water to which no chemicals were added. Wastewater sources included plant air compressors, refrigeration condensers, diesel jacket water coolers, and water chillers. The average temperature of water from the LOFT production well is 11.1°C, while the cooling water was discharged down the injection well at an average temperature of 25.6°C. Average water flow to the well was 1500 m^3/d (400,000 gal/d). The injection well was used until May 1980, by which time changes were made to the cooling system for partial recycling of the cooling water with ultimate disposal in the LOFT pond.

Since the injection well's construction significantly predates that of the LOFT facility (1957 versus 1973), it can be assumed that the well was constructed for purposes other than to receive LOFT wastewater. The well was probably constructed in conjunction with the ANP Program. The quantities or types of wastewater that may have been injected during the

ANP days are unknown. However, considering the limited ANP activities that occurred at the current LOFT area, it is unlikely that significant quantities of hazardous or radioactive wastes were involved.

4.4 TAN/IET Past Activity Review

4.4.1 TAN/IET Description

The Test Area North (TAN)/Initial Engine Test (IET) facility is located in the northern part of the INEL, about one mile north of the TSF complex, as was shown in Figure 3.3. It is part of the TAN facilities and was originally constructed as the initial engine test area for the ANP Program. Figure 4.4.1 provides a plot plant of the IET area. The facility consists of an underground control and equipment building and various other small service buildings. Although constructed as part of the ANP program, the IET facility has been used for two subsequent programs. A description of the three programs that utilized the facility are described in the following paragraphs.

4.4.1.1 Aircraft Nuclear Propulsion (ANP) Program. The ANP Program, for which the IET was initially constructed, began in 1951 and ended in 1961. The experiments were called Heat Transfer Reactor Experiments (HTRE).

The HTRE power plants or test assemblies, stored in the TAN/TSF area, consist of the Core Test Facility and the nuclear reactor. The core components are mounted on a structural steel platform called a dolly. The platform units were rolled over a four-rail railroad track so the assembly could be moved between TAN/TSF and TAN/IET, where the tests were conducted.

The HTRE experiments included the following:

- HTRE-1. The HTRE-1 reactor operated a modified J47 turbojet engine exclusively on nuclear power in January 1956. It accumulated a total of 150.8 hours of operation at high nuclear power levels.

- HTRE-2. The HTRE-2 reactor was a modification of HTRE-1. Testing began in July 1957. The reactor accumulated 1299 hours of high-power nuclear operation.

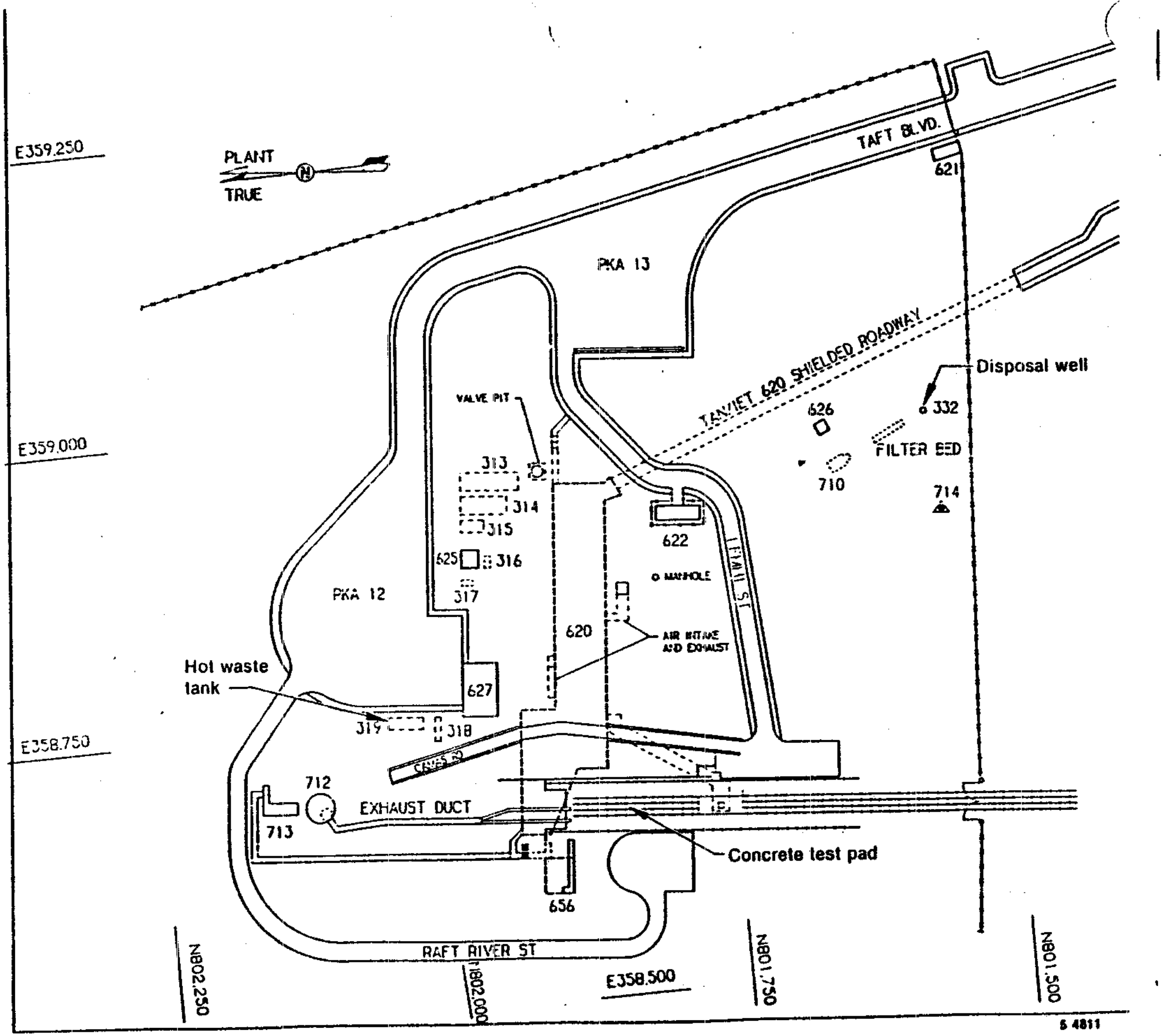

Figure 4.4.1. Test Area North/Initial Engine Test (TAN/IET) facility plot plan.

- HTRE-3. The HTRE-3 reactor was built in a full-scale aircraft reactor configuration. Two modified J47 turbojet engines were operated by this reactor. Full nuclear power was achieved in 1959 and the system operated for a total of 126 hours.

The HTRE-2 and -3 core components are currently being stored within TAN/TSF Radioactive Parts Security and Storage Area (RPSSA). Decontamination and decommissioning of these test assemblies are scheduled for the near future.

4.4.1.2 Space Nuclear Auxiliary Power Transient (SNAPTRAN) Program. The SNAPTRAN Prgram ran from 1961 through 1967. It involved the following tests.

- A series of test aimed at providing information about beryllium-reflected reactor performance under atmospheric conditions and assessing hazards during reactor assembly and launch,

- Nuclear excursions resulting from immersion of the reactor in water or wet earth,

- Nondestructive tests including static tests and those kinetic tests in which minor damage to the reactor occurred, and

- Destructive tests in which the reactor was destroyed.

4.4.1.3 Hallam Decontamination and Decommissioning (D&D) Project. The Hallam D&D Project was conducted in 1977 and 1978. It included the following:

- Storing, in the hangar at TAN/LOFT, various components shipped to the INEL in 1968 from the dismantled Hallam Nuclear Power Facility near Lincoln, Nebraska;

- o Moving the components to the IET for removal of the sodium from the components;

- o Decontaminating the components, when feasible, for use in research and development, and for disposal as surplus materials; and

- o Sending materials that could not be decontaminated to the Radioactive Waste Management Complex for disposal.

4.4.2 TAN/IET Wastes Generated by Specific Acitiviy

Waste generations are addressed in the following paragraphs according to the program involved. A summation of the hazardous waste generations is found in Table 4.4.1.

4.4.2.1 ANP Program. The IET facility was designed for this program; it is the only program for which all of the IET facility was used. During this program, IET was the site where the HTRE reactors and associated jet engines were actually run-up. Any significant maintenance or repair was accomplished at TSF. The main sources of chemical or radioactive contamination were the concrete test pad where the reactors/engines were tested, and the tank building (TAN-627) where ion exchange columns were operated for cooling water.

The concrete test pad, on the west side of TAN-620, was the place of generation of radioactively contaminated wastewater at the IET facility. The contamination may have been caused by spills, leaks or minor maintenance work. Runoff from the pad was channelled into a cistern which gravity fed the hot waste tank shown in Figure 4.4.1 as TAN-319. Although radiation was the main source of contamination, it is possible the mercury spills may have occurred here during HTRE-3 testing. HTRE-3 used a shield augmentation system to provide additional gamma shielding for the reactor after shutdown by replacing the water in the primary shield outer tank with mercury. During augmentation the primary shield contained 48,000 kg (106,000 pounds) of mercury which provided the necessary mass around the reactor to allow contact maintenance to be performed. Since mercury has

TABLE 4.4.1. TAN/IET HAZARDOUS WASTE GENERATION

Location	Function	Waste Stream	Timeframe	Estimated Quantities (if known)	Treatment/ Storage/ Disposal
Concrete Test Pad	Operating location for HTRE-reactors during ANP program	Mercury	1959	Unknown	Hot waste collection system
TAN-627	Tank building--maintain cooling water quality during ANP program	Ion exchange column regenerants o Sodium hydorixde o Sulfuric acid	1956-1959	 750 kg 860 kg	IET injection well after at least partial neutralization
Concrete test pad	Location for Hallam D&D project--sodium processing	Corrosive wastewater--pH >13.5	1978	51,000 L	Neutralized on-site, then dump at TAN-735

been found in hot waste collection lines (to be discussed further in Section 4.4.2.5), it can be assumed that spillage on the concrete pad is the source.

The tank building (TAN-627) was the location for ion exchange columns used to maintain the cooling water quality for the HTRE tests. Sodium hydroxide and sulfuric acid were used to regenerate the demineralizers and the regenerant solutions were discharged to the IET disposal well (TAN-332). The demineralizers were generated about every 24 hours of full use, that is after about 24 hours of HTRE test being run. Since the HTRE reactors accummulated a total of 1578.8 hours of operation, it can be assumed that the demineralizers were regenerated approximately 66 times. Each regeneration used about 11 kg (25 pounds) of sodium hydroxide and 13 kg (29 pounds) of sulfuric acid, for a total chemical usage of about 750 kg (1650 pounds) of sodium hydroxide and 860 kg (1910 pounds) of sulfuric acid. The regenerant solutions went to a common tank before discharge to the injection well, so they were at least partially neutralized.

It should be noted that the IET was designed such that exhaust from the HTRE reactor/engine assemblies were discharged to a large exhaust duct and stack system. There is significant radioactive contamination inside this exhaust system. It has already been characterized and is scheduled for future decontamination and decommissioning (D&D) work. Therefore, it will not be addressed further in this document.

4.4.2.2 <u>SNAPTRAN Program</u>. As part of the SNAPTRAN Program, IET was again used as the site for testing the operation of small mobile reactors. The concrete pad on the west side of TAN-620 was the primary test location. Any contaminated wastewater was drained to the hot waste collection system. There are no records of the SNAPTRAN program having generated hazardous waste at the IET facility.

Again, it should be noted that the last phase of the SNAPTRAN program involved the destruction of a small reactor. Debris and component parts have all been removed but some radioactive contamination remains in the area. The D&D effort has already characterized the contamination and, if necessary, additional cleanup of the area will be addressed in the scheduled D&D effort.

4.4.2.3 Hallam D&D Project. As mentioned earlier, the portion of the Hallam D&D effort that was accomplished at IET consisted primarily of removing reactive sodium metal from various reactor components. Simplified, the process consisted of injecting wetted nitrogen gas into the components. The wetted nitrogen gas reacts with the sodium producing gaseous hydrogen and sodium hydroxide. After the vessels had been processed in this manner, they were filled with water and allowed to stand for three days. The purpose for the water was to react any sodium remaining in the component. After the three days were over, the components were left containing a wastewater that was highly corrosive (pH greater than 13.5) and radioactively contaminated and which also required disposal.

It was decided to neutralize the wastewater before any disposal took place. The caustic wastewater was drained to a rinse tank in batches and slowly neutralized with concentrated sulfuric acid. The neutralized wastewater was then taken to TAN/TSF by tank truck where it was dumped in the acid pond (TAN-735) which is part of the RPSSA. After each of the Hallam components were drained, they were refilled with fresh water and retested to ensure pH was 7.0. This refill water was also pumped to the tank truck and hauled to the acid pond. Approximately 51,000 L (13,400 gallons) of corrosive wastewater was neutralized in this manner.

After the Hallam D&D operations at IET were completed, all components were removed from the facility for salvage or burial at the RWMC if still radioactively contaminated. The Hallam D&D project involved no disposal activities at the IET facility.

4.4.2.4 IET Fuels/Petroleum Management. During the ANP program days, bulk fuel management included engine fuel, diesel fuel, heating fuel and gasoline in underground tanks TAN-313 (50,000 gallons), TAN-314 (30,000 gallons), TAN-315 (20,000 gallons), and TAN-318 (5,000 gallons) respectively. Engine fuel, diesel fuel, and gasoline were all utilized in jet engine testing. One three inch fuel line from TAN/TSF provided the supply for at least engine fuel. Fuel not received by way of this line was delivered in tank trucks. The fuel transfer pumping building (TAN-625) housed the pumps that moved the fuel to and from the concrete pad test area. Since the ANP days, the gasoline tank (TAN-318) has been abandoned and the three remaining tanks have been used periodically to store No. 2 fuel oil. These three tanks (TAN-313, -314, and -315) are all shown on Figure 4.4.1.

There are no records of significant fuel leaks from these tanks and no obvious signs of environmental stress due to spillage or leaks.

4.4.2.5 Spills Within IET. Review of UOR's personnel interviews, observations and operation records provided information on the spills identified in this section.

During the original construction of the IET facility, it was envisioned that radioactive wastewater would be generated, either by spillage or draining, on the concrete test pad west of TAN-620. Water collected on this pad drained to the hot waste collection system. However, during a September 1985 D&D project on the underground line connecting the concrete pad to the Hot Waste Tank (TAN-319 in Figure 4.4.1) contamination in addition to radioactivity was found. When one section of pipe was removed from the excavation trench, a sludge material drained from one end and was found to contain mercury. As mentioned previously, the HTRE-3 reactor utilized great quantities of mercury as shielding and apparently some was lost while the reactor was sitting on the concrete test pad. It is felt that the piece of pipe removed was a low section where the mercury had accummulated and had never been flushed out. However, the rest of the pipe will be suspect of containing mercury as will the sludge that sits in the bottom of the Hot Waste Tank.

During the Hallam D&D project, there were numerous small spills of caustics and acids mentioned in operation reports, but they were limited to small spills caused by corrosion of pipe and pump fittings. In all cases the reports indicated the spills were neutralized and cleaned up.

4.4.3 TAN/IET Waste Disposal Sites

Areas of sites within the IET facility at which hazardous and/or radioactive wastes may have been deposited are discussed in the following paragraphs. A summary of the hazardous waste findings is presented in Table 4.4.2.

4.4.3.1 IET Hot Waste Collection System.

4.4.3.1.1 Description--Radioactive liquid wastes generated at the IET Facility were moved by gravity to a 56,800 L (15,000 gallon) underground waste holding tank (TAN-319 on Figure 4.4.1). Depending upon the quantity and level of activity, the waste was transported either to the ICPP for processing or pumped to the TSF Intermediate-Level Waste Dispsoal System (see Section 4.2.3.3). The radioactive liquid wastes were generated from tests performed at the concrete test pad.

4.4.3.1.2 Wastes Received--D&D operations have already been completed on the hot waste line that connected the IET Hot Waste Tank (TAN-319) with the TSF disposal system and D&D operations are currently underway on the line that fed the Hot Waste Tank. Because of the mercury found in the later section of pipe (see Section 4.4.2.5), it is estimated that the current D&D operation will generate 15 drums of radioactive and hazardous mixed waste.

TABLE 4.4.2 TAN/IET HAZARDOUS WASTE DISPOSAL SITES

Site	Site Name	Period of Operation	Area Size (km^2)	Suspected Types of Wastes	Estimated Quantity of Waste	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
TAN-319	IET hot waste tank	1956 - 1978	NA	Mercury contaminated sludge	6,000 L of sludge (extent of mecury contamination, if any, is unknown)	Radioactively contaminated wastewater from the concrete test pad is collected in this tank before being pumped to TSF or trucked to ICPP. Over the years sludge has accummulated in the tank.	Closed - piping to tank has just recently been capped - until then test pad runoff was reaching the tank and overflowing it.	Snake River Plain Aquifer underlies the site at a depth of about 64 m. Surface is generally level. Subsurface consists of alternating layers of basalt and silt.	The underground tank is now closed from runoff sources.	Presence of mercury is unknown, only suspect.
TAN-332	IET injection well	1956 and 1978	N/A	Ion exchange column regenerants - Sodium hydroxide - Surfuric acid	 750 kg 860 kg	Regenerant solutions were mixed in a tank and at least partially neutralized prior to discharge to the injection well.	Closed	Some	Well head is closed to surface drainage.	None

a. These materials (acids and bases) were at least partially neutralized before being discharged to the pond.

The Hot Waste Tank itself contains liquid and sludge that has been radiologically characterized. The sludge is considered contaminated waste but the liquid is not. (The liquid has accummulated from precipitation falling on the concrete test pad and draining to the hot waste collection system.) The sludge in the tank is estimated to be about 6,000 L (about 10% of the tank's volume). If it is assumed that the sludge consists of 300 grams of solid material per liter of sludge, Table 4.4.3 provides an estimated curie content of the sludge. Although radiologically characterized, the tank contents have not been analyzed for hazardous chemical constituents and because of the mercury found in pipes upstream from the tank, mercury contamination of the sludge is suspect. It is possible that all the mercury that found its way to the collection system stayed in low spots in the line before reaching the tank, but depending on the quantities spilled, this appears unlikely. There is a better chance, however, that any mercury reaching the Hot Waste Tank would have stayed in the tank bottom rather than being pumped to a tank truck or to the TSF disposal system. Again, it would all depend on the amount of mercury spilled, but because of mercury's density and relative insolubility in water, if any reached the tank it would be in the sludge. The Hot Waste Tank sludge is scheduled to be addressed in future D&D efforts at IET. Before these D&D efforts can be started, the sludge will have to be resampled for hazardous chemical constituents, particularly mercury.

4.4.3.2 <u>IET Injection Well (TAN-332)</u>.

4.4.3.2.1 <u>Description</u>--The IET injection well is located southwest of the main control facility (TAN-620) as shown in Figure 4.4.1. The well is 98.9 meters (324 ft) deep and information is unavailable on its casing size. Depth to groundwater in this area is approximately 64 meters (210 ft).

4.4.3.2.2. <u>Wastes Received</u>--Regeneration backwash from the cooling water treatment equipment and other nonradioactive liquid wastes were discharged to the IET injection well. It is suspected that

TABLE 4.4.3. CURIES CONTAINED IN IET HOT-WASTE-TANK SLUDGE

Radionculide	Concentration (Ci/g)		Total Curies[a]
Cobalt-60	4.3×10^{-11}		7.74×10^{-5}
Cesium-137	4.44×10^{-10}		7.99×10^{-4}
Uranium-235	4.0×10^{-12}		7.2×10^{-6}
Strontium-90	5.1×10^{-9}		9.18×10^{-3}
		Total	1.01×10^{-2}

a. At an assumed solids content of 300 g/l and an estimated sludge volume of 6,000 L.

wastewaters from these sources only occurred during the time that the ANP program was active at IET (1956-1961). As mentioned in Section 4.4.2.1, the regeneration backwash contained a total of about 750 kg of sodium hydroxide and 860 kg of sulfuric acid. However, operations were such that the regenerant solutions were mixed and, at least, partially neutralized prior to discharge to the injection well.

The IET injection well also received septic tank overflow from the facility's sanitary sewer collection/disposal system. Sanitary sewer would flow from the facility to a septic tank system south of the area. The septic tank itself is shown as TAN-710 in Figure 4.4.1. Effluent from the septic tank was chlorinated, passed through a sand filter, and discharged to the well. The sanitary sewer system is not a suspected source of hazardous chemcials to the injection well.

4.4.3.3 <u>IET Sanitary Sewer System</u>.

4.4.3.3.1 <u>Description</u>--As mentioned in the previous paragraph, the IET sewer system consisted of collection lines, a septic tank, chlorination, sand filtration, and discharge to the IET injection well. The septic tank itself is a 10,600 L (2,800 gallon) unit with a design capacity of 7,600 L (2,000 gallons) per day.

4.4.3.3.2 <u>Waste Received</u>--The IET Sewer system was designed to receive sanitary sewage waste only. However, during the radiological characterization of the IET site, the sludge that remains in the septic tank was analyzed and found to contain measureable concentrations of some radionuclides. The sludge in the tank is estimated at about 1,100 L (about 10% of the tank's volume). If it is assumed that the sludge consists of 300 grams of solid material per liter of sludge, Table 4.4.4 provides an estimated curie content of the sludge. The septic tank sludge is scheduled to be addressed in future D&D efforts at IET.

TABLE 4.4.4. CURIES CONTAINED IN IET SEPTIC-TANK SLUDGE

Radionculide	Concentration (Ci/g)		Total Curies[a]
Cesium-137	8.8×10^{-11}		2.9×10^{-5}
Strontium-90	5.6×10^{-10}		1.8×10^{-4}
		Total	2.1×10^{-4}

a. At an assumed solids content of 300 g/l and an estimated sludge volume of 1,100 L.

4.5 TAN/WRRTF Past Activity Review

4.5.1 TAN/WRRTF Description

The Test Area North (TAN)/Water Reactor Research Test Facility (WRRTF) is located in the northern part of the INEL, about 1-1/4 miles south-southeast of the TSF complex, as shown in Figure 3.3. Like IET it is part of the TAN facilities and was originally constructed as part of the ANP program. Figure 4.5.1 provides a plot plan of the WRRTF area. As can be seen in Figure 4.5.1, with the exception of some small support/utility type buildings, the WRRTF area consists primarily of two building complexes: one identified as TAN-640/641 and the other as TAN-645/646. These two building complexes have gone through several modifications and usages since the time of the ANP program. The following paragraphs provide a brief description of the work/research that has been done in these two complexes.

4.5.1.1 TAN-645/646. This complex was originally constructed in 1958 as the Shield Test Pool Facility (STPF). It was composed of two adjacent buildings; one housed administrative offices, utility areas, and a reactor control room, and the other was a large high bay building with an overhead crane and two deep pools. During the ANP program one pool contained a "swimming pool" type reactor designated as "SUSIE" and the other pool was used as a storage space for fuel elements and radioactive experimental equipment.

In 1961, after termination of the ANP program, SUSIE was modified such that the pool water was forced through the reactor and then through a heat exchanger. The reactor was still used as a radiation source for experiments but at a higher power (2 MW versus 10 kW before modifications). The reactor was operated in this mode for approximately one year and was then dismantled and shipped to the Sandia Corporation at Albuquerque, New Mexico.

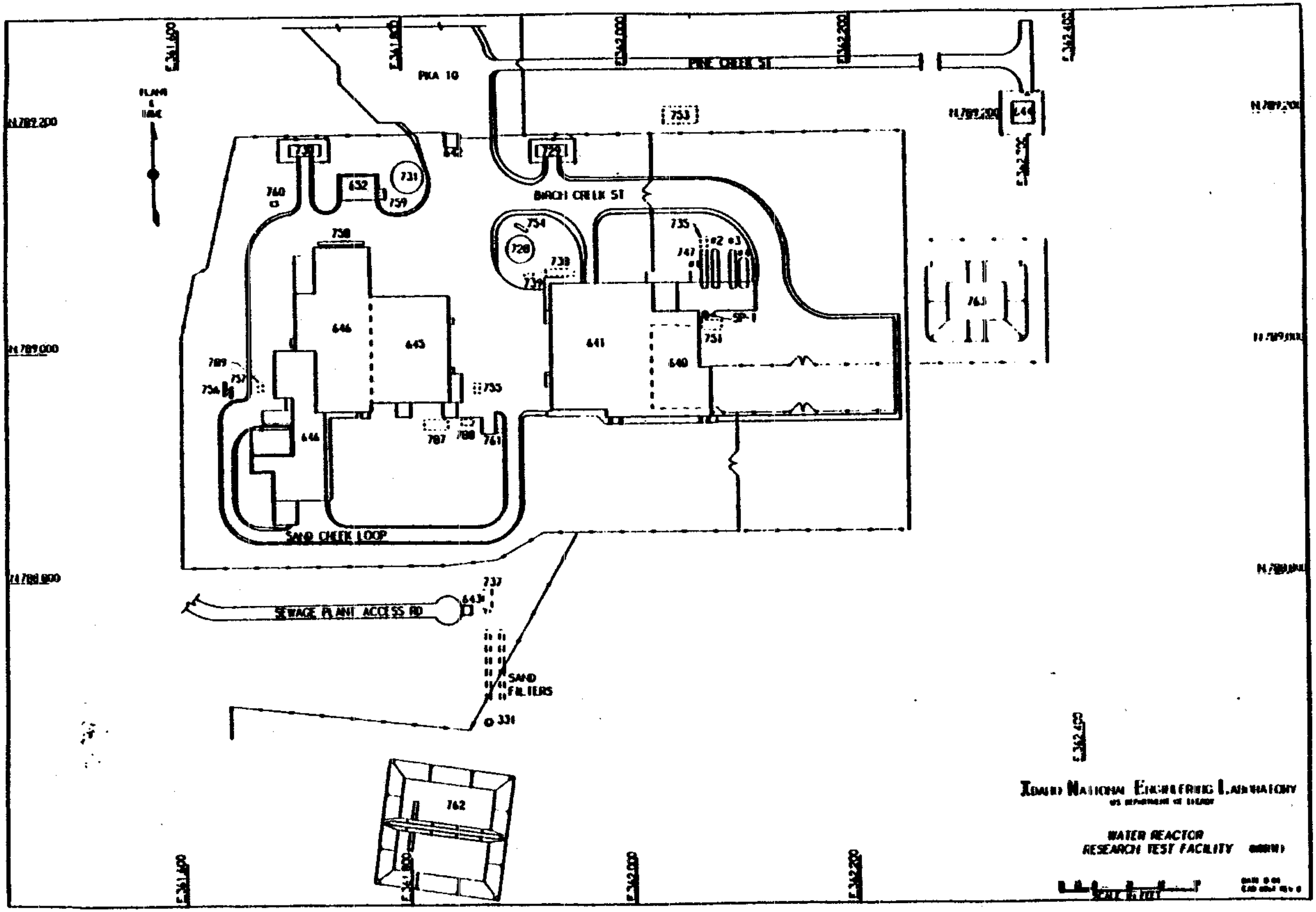

Figure 4.5.1. Test Area North/Water Reactor Research Test Facility (TAN/WRRTF) Plot Plan.

Modifications began again on the facility in 1963 to house the Experimental Beryllium Oxide Reactor (EBOR). However, the EBOR program was terminated in 1966 before fuel was inserted into the reactor, and the facility subsequently has been used for nonnuclear testing programs.

Since EBOR, the TAN-645/646 complex has housed the Semiscale program. Semiscale in a nonnuclear program that simulates the principal thermal-hydraulic features of a commercial nuclear reactor on a much smaller scale in order to predict what occurs in a nuclear system during a loss-of-coolant accident and other transients. Testing is performed in the Semiscale Facility as research for the Nuclear Regulatory Commission and to assist the LOFT program.

4.5.1.2 TAN-640/641. This complex was constructed in 1958 and historically has most often been referred to as the Low Power Test (LPT) facility. It comprises two large concrete shielded cells (which have housed test reactors) and an associated building with control rooms, office space and utilities.

The facility was designed to conduct tests on engineering "mockups" of real or proposed reactor systems. These tests, conducted at low or near zero power, required no heat removal systems. During the ANP program, the facility was used for pretesting reactor cores in a specifically designed tank before those cores were transported to the IET facility for high-power testing. The LPT facility has been utilized subsequently for a number of specialized low-power tests.

After several years of being used primarily as office space for activities in the adjacent facility (TAN-645/646), this building has more recently been remodeled to support tests for the LOFT program. Until the recent completion of the LOFT program, TAN-640/641 has housed the Blowdown and Two-Phase-Flow Loop facilities. The Blowdown test loop has been used to assess and calibrate LOFT external fuel cladding thermocouples under transient conditions, to test the performance of LOFT flow instrumentation, to study basic blowdown heat transfer, to qualify the Power Burst Facility blowdown valves, and to test the performance of the Semiscale scaled high-speed pump. The Two-Phase-Flow-Loop is a large, high-temperature steam-water test system designed and installed to test LOFT flow instrumentation over the full range of two-phase-flow conditions expected to occur during a LOFT blowdown.

4.5.2 TAN/WRRTF Wastes Generated by Specific Activity

Waste generations are addressed in the following paragraphs according to the buildings and operations involved. A summation of the hazardous waste generations is found in Table 4.5.1.

4.5.2.1 TAN-640. During the ANP program and for some time subsequently, the shielded cells of this building were used to perform low power reactor tests. The tests were done at such low power that cooling water was never needed, thus eliminating a major source of waste for most reactor operations. However, because reactor fuel was handled in the facility, often unclad uranium, provisions were made in the facility's design to handle any wash or other wastewater as radioactively contaminated. It drained to the facility's radioactive liquid waste disposal system. No other hazardous wasted were generated at the facility while it was used for low power testing.

The most current use of this facility has been to house the Blowdown Test Loop and the Two-Phase-Flow Loop. Wastes from these non-nuclear tests are limited to wastewater, some of which is pretreated to maintain a desired water chemistry. Water for the Two-Phase-Flow Loop testing has hydrazine added to act as an oxygen scavenger. Although hydrazine itself is highly hazardous, the make-up waste for the test contains only about 0.27 mL of hydrazine per L of water and is not considered hazardous.

4.5.2.2 TAN-641. This facility provides office and utility support to the tests accomplished in the adjoining TAN-640. The only industrial-type waste streams associated with this building are

TABLE 4.5.1. TAN/WRRTF HAZARDOUS WASTE GENERATION

Location	Function	Waste Stream	Time Frame	Estimated Quantities (if known)	Treatment/Storage/Disposal
TAN-640	Two-phase-flow-loop	Wastewater (from testing) containing hydrazine in very small quantities	1981-Present	0.27 mL/L	Discharge to two-phase pond
TAN-641/646	Demineralizers	Regeneration solutions (acidic and basic)	1958-1984	Unknown	Neutralized and discharged to disposal well
			1984-Present	Unknown	Neutralized and discharged to seepage pond

regeneration solutions from a demineralizer unit and blowdown of boiler condensate return water. The regerants are alternately acidic or caustic through use of sulfuric acid or sodium hydroxide, respectively. However, it is reported that the regenerants are always neutralized or diluted by the time they are discharged such that they are nonhazardous. Make-up water to the steam boilers is treated with sulfites and phosphates to control corrosion and scaling. The blowdown from the system also contains these chemicals but is not considered hazardous. Process water is also softened in this facility, resulting in the discharge of brine.

4.5.2.3 TAN-645. Tradionally this facility has provided administrative and control space for the operations accomplished in TAN-646. There is no record of hazardous waste streams from this facility.

4.5.2.4 TAN-646. During its days as part of the Shield Test Pool Facility (STPF) this building not only housed the pools; but it contained water softeners and demineralizers that preconditioned the water. Brine from the water softening operation as-well as acidic and caustic regeneration solutions from the demineralizer all flowed to a neutralizing pit prior to discharge to the area's disposal well. Blowdown from the steam heating system was also discharged to the well but contained only small quantities of sulfites and phosphates as water conditioners.

The pools of the STPF produced no liquid radioactive wastes. They were equipped with a clean up system filter which removed radioactive material from the pool water, and the filters where shipped to the RWMC. There are no records of any other hazardous waste streams from this facility.

4.5.2.5 WRRTF Fuels/Petroleum Management. Bulk fuels used at WRRTF have included No. 2 and No. 5 fuel oils, diesel fuel and gasoline. The single gasoline tank is now abandoned. All fuel tanks are supplied fuel from tank trucks. There are no records of any significant fuel spills occurring at the WRRTF area. Table 4.5.2 provides an inventory of the fuel/petroleum storage tanks at WRRTF. The locations are shown by facility number in Figure 4.5.1.

4.5.2.6 Spills within WRRTF. Review of UOR's, personnel interviews, observations and operation records provided information on only one spilled that occurred at WRRTF. The exact date was not recorded, but it probably occurred in the mid-1960's and took place at the TAN-645/646 complex. A pump that had been used in other reactor experiments was hooked up wrong and a section of the pump which had not been decontaminated was flushed out. This resulted in contamination of an industrial water line and discharge of about 50 nCi of cobalt-60 activity. At least one reference states the activity was discharged to a disposal pond. However, there is no record of there being a disposal pond at WRRTF during this time frame and it is suspected that the activity was discharged to the injection well.

4.5.3 TAN/WRRTF Disposal Sites

Areas or sites within the WRRTF facility at which hazardous and/or radioactive wastes may have been deposited are discussed in the following paragraphs. A summary of the hazardous waste findings is presented in Table 4.5.3.

4.5.3.1 WRRTF Injection Well (TAN-331).

4.5.3.1.1 Description. The WRRTF injection well at TAN-331 (see Figure 4.5.1) was first used in 1957. The well is 95.4 m (313 feet) deep and has a 20.3 cm (8 inch) diameter casing to a depth of 8.8 m (29 feet) and a 10.2 cm (4 inch) casing to a depth of 9.1 m (30 feet). Depth to groundwater is approximately 64 m (210 feet). The injection well was last used in August of 1984. Beginning in September of 1984 the water which was flowing to the injection well was diverted to a newly constructed evaporation pond which is contiguous to the WRRTF sewage lagoon. The disposal well was then plugged with concrete and capped on September 11, 1984.

TABLE 4.5.2. WRRTF FUEL/PETROLEUM STORAGE TANKS

Location	Oil Type	Maximum Capacity (g)	Above (A), Underground (U), Outside (O), Inside (I)	Level Check	IMMX No.	Responsibility	Comments
TAN-751 (WRRTF)	Diesel No. 2	12,000	U, O	Dipstick	01BFW619	Plant Services	--
TAN-753 (WRRTF)	No. 5 fuel oil	55,000	U, O	Dipstick	01BFW661	WRRTF	--
TAN-787 (WRRTF)	No. 2 fuel oil	10,240	U, O	Aboveground gauge	01BFW656	Plant Services	Coated; outside fence on north side
TAN-652 (WRRTF)	Diesel No. 2	300	A, I	Dipstick	--	Plant Services	--
TAN-738 (WRRTF)	No. 2 fuel oil	10,240	U, O	Aboveground gauge	01BFW655	Plant Services	--
TAN-739 (WRRTF)	Diesel No. 2	1,000	U, O	Aboveground gauge	--	WRRTF	--
TAN-788 (WRRTF)	No. 2 fuel oil	2,500	U, O	Aboveground gauge	--	--	Abandoned
TAN-789	Diesel	?	U, O	Aboveground gauge	--	--	Abandoned
TAN-755 (WRRTF)	No. 2 fuel oil	5,000	U, O	Aboveground gauge	--	--	Abandoned; next to TAN-645
TAN-644 (WRRTF)	Gasoline	550	U, O	--	--	--	Abandoned; outside fence on northeast side

TABLE 4.5.3. TAN/WRRTF HAZARDOUS WASTE DISPOSAL SITES

Site	Site Name	Period of Operation	Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Wastes	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
TAN-331	WRRTF injection well	1957-1984	NA	Ion exchange column regenerants Cobalt-60	Unknown 50 mCi	Corrosive waste was neutralized or diluted with other wastewater prior to the discharge to well. Other industrial wastewaters discharged directly.	Closed-well capped and sealed as of September 1984.	Snake River Plain Aquifer is about 64 m below the surface which is generally level. Subsurface consists of alternating layers of basalt and silt.	Well head is sealed against surface water intrusion.	
TAN-762	WRRTF sewage lagoon/ evaporation pond	1984-present	16,400	Ion exchange column regenerants	Unknown	Neutralized or diluted with other wastewater prior to discharge.	Active grab samples have shown pH value of discharge to pond to be non-hazardous.	Same	Lagoon/pond has earthen berms to prevent surface water intrusion.	
TAN-763	WRRTF two-phase pond	1981-present	450	Water conditioned with small concentration of hydrazine.	708,000 L of water with 5 ppm hydrazine (i.e., 3.5 L of hydrazine).	Discharged directly to pond with earthern berms and bottom.	Active but used only periodically, when two-phase-flow testing is being done.	Same	Pond has earthen berms to prevent surface water intrusion.	
TAN-735 and adjacent discharge area	WRRTF radioactive liquid waste disposal system.	1957-1977	Unknown	Radioactive contaminated wash water from reactor test cell areas of TAN-640.	Unknown-below release criteria of DOE Order 5480.1A.	Each tank fully analyzed and found to be below release criteria - tank discharged to surface.	Surface discharge area no longer used survey has shown no activity above background.	Same	Surface discharge area has no surface discharge protection.	
		1977-Present	NA		Unknown-expected to be minimal, if any.	Collected wastewater is routinely taken to TSF disposal pond independent of activity, if any.	Tank collection system still in operation.		Tank is located underground and has no problems with surface drainage intrusion.	
	WRRTF Burn Pit	1958-1967	3,000	Garbage and burnable debris Fuel oil Lubrication oil Zinc-bromide oil Stoddard Solvent	Unknown-lube oil and Stoddard Solvent probably amount to at least 9,5000 L over the 10 year period.	Waste dumped into pits and ignited. As a pit began to fill with rubble, it was covered and another pit was opened.	Closed-all pits filled in and surface is graded level.	Same	No provisions were made to prevent surface drainage run-on.	

a. These materials (acids and bases) were at least partially neutralized prior to release.

4.5.3.1.2 Wastes Received--The injection well received boiler blowdown, non-radioactive process waters, and cooling water. The major known sources of liquid chemical wastes were NaCl from water softening, NaOH and H_2SO_4 from demineralization, and Na_2SO_3, Na_2HPO_4, and Na_3PO_4 from corrosion and scaling control. The brine (NaCl), sulfite, and phosphate solutions are considered non hazardous. The basic (NaOH) and acidic (H_2SO_4) wastewaters can be hazardous but were reported to be neutralized before any discharge to the injection well. The volume and calculated concentrations of expected ions in the waste streams are determined monthly and published in the Industrial Waste Management Information System (IWMIS) yearly report. These yearly reports, however, do not take into consideration any neutralization.

Prior to 1981, the injection well also received treated domestic wastewater from WRRTF operations. Domestic waste generated at the facility first goes to a septic tank and overflow from the septic tank flows into a sand filter with an aerator. Until the WRRTF sewer lagoon was constructed in 1981, the effluent from the sand filter was pumped to the injection well.

As discussed in Section 4.5.2.6; it is also suspected that about 50 mCi of cobalt-60 activity was released to the injection well in the 1960's.

4.5.3.2 WRRTF Sewage Lagoon/Evaporation Pond (TAN-762).

4.5.3.2.1 Description--In 1981 a two-cell sewage lagoon was constructed to receive WRRTF sewage as it leaves the septic tank/sand filter treatment system. In 1984 the south cell of the lagoon was expanded and converted into an evaporation pond for those process and industrial wastewaters that were going to the injection well. As now used, the sewage lagoon is one cell with a capacity of about 1.1×10^6 L (2.9×10^5 gallons) and the evaporation pond is a large extension of the second cell achieved by removing the southern berm shown in Figure 4.5.1. The large spreading area now joined with the second cell is approximately

128 m square. The two cells are still separated by a berm and it is anticipated that the domestic wastewater flow from WRRTF will not overflow the one-cell sewage lagoon.

4.5.3.2.2 Wastes Received--From 1981 through August 1984 the two-cell sewage lagoon received nothing but domestic wastewater after it had passed through the septic tank/sand filter treatment system. Since September 1984 only the first cell has been used to receive the domestic wastewater and the enlarged second cell (now called the evaporation pond) has received process and industrial wastewaters. The water going to the second cell has contained diluted solutions of brine, sulfite, phosphates, acids, and bases. Only the corrosive acids and bases are considered hazardous and they are neutralized prior to discharge to the evaporation pond.

4.5.3.3 WRRTF Two-Phase Pond (TAN-763).

4.5.3.3.1 Description--The two-phase pond was constructed in 1981 to handle the wastewater discharge from the Two-Phase-Flow Loop test system operated in the TAN-640/641 structure. The pond is located on the east side of the WRRTF facility as shown in Figure 4.5.1. Its approximate dimensions are 30 m (98 feet) long by 15 m (50 feet) wide by 3 m (10 feet) deep and its capacity is about 1.4×10^6 L (3.7×10^5 gallons). The pond was constructed with earthen berms and an earthern bottom.

4.5.3.3.2 Wastes Received--The two-phase pond is used only during the two-phase loop experiments. It receives process wastewater approximately once a month with small amounts of hydrazine which is used as an oxygen scavenger. The original concentration added to the process water is 80 mL per 300 liters of water or 0.27 mL/L. The pond received 511,000 L of wastewater in 1981 and 197,000 L in 1984; no wastewater was generated from two-phase-flow testing in 1982 or 1983 and none has been generated thus far in 1985. Assuming that the hydrazine make-up concentration of 0.27ml/L is also true for the wastewater, the 708,000 L of wastewater would contain about 191 L of hydrazine. However, as the hydrazine scavenges oxygen from the test loop it is oxidized and the wastewater resulting is expected to have lower hydrazine concentrations. Limited analytical results have shown hydrazine concentrations in the wastewater to be as high as about 5 ppm. At this level, only about 3.5 L of hydrazine has been discharged to the pond. No other hazardous or radioactive constituents are expected to be present in the discharge to the two-phase pond.

4.5.3.4 <u>WRRTF Radioactive Liquid Waste Disposal System</u>.

4.5.3.4.1 <u>Description</u>--As described in Section 4.5.2.1, the reactor test cell areas in TAN-640 were provided "hot" waste floor drains in case any wash or other wastewater might contain radioactive contamination. These drainlines exit the building to the north and discharge to a 3,000-gallon underground tank identified as TAN-735 in Figure 4.5.1. Prior to the 1976/1977 timeframe, normal procedure called for pumping the contents of the tank, if they were above the limits for discharge to the environment, into a tanker truck for transport to the TSF or ICPP radioactive liquid waste process systems; otherwise, the waste was pumped directly to a surface area just north (across Birch Creek St) of the tank. Since the 1976/1977 time frame all wastewater collected in the tank has been pumped and trucked to the TSF disposal pond independent of whether or not there is any radioactive contamination.

4.5.3.4.2 <u>Wastes Received</u>--This collection/disposal system was installed because of the possibility of radioactive contamination occurring in certain areas of the building; there was never a routinely contaminated liquid waste stream generated. Historically, the TAN-735 tank has required emptying only about once or twice a year.

Prior to the 1976/1977 time frame the wastewater accumulated in the tank was always found to be below the activity levels established as suitable for discharge to the environment. Therefore, the contents were discharged to the ground just north of the tank and Birch Creek Street. In 1980, areas around WRRTF, including the area which received the tank discharge, were survey for beta-gamma activity. A Geiger-Mueller counter with a pan-cake probe was used. The survey identified no significant beta-gamma activity above background levels and the discharge area is not expected to present a potential environmental problem.

Since the 1976/1977 timeframe, the tank contents have been trucked to the TSF disposal pond. Radioactivity levels are still expected to be minimal, if any, and the discharge is included in the data reported in the Radioactive Waste Management Information System (RWMIS) as going to the TSF disposal pond. An area of possible concern, however, is the sludge that has accumulated in the bottom of the TAN-735 tank. It is suspected that the sludge is radioactively contaminated, but there is no record of samples having been taken. This may be an area warranting future investigation.

4.5.3.5 WRRTF Burn Pit.

4.5.3.5.1 Description.--The WRRTF burn pit area was utilized from 1958 to the 1966/67 time frame. It was located on the east side of a small dirt road (now blocked) that ran north and south between WRRTF and State Highway 33 as shown in Figure 4.5.2. The area consisted of three pits for garbage and burnable debris and in 1961 or 1962 a fourth, smaller, pit was dug for liquid petroleum product wastes. The dimensions of the three larger pits, (all side-by-side) were approximately 6 m (20 feet) wide by 61 m (200 feet) long, 12 m (40 feet) wide by 61 m (200 feet) long, and 15 m (50 feet) wide by 76 m (250 feet) long. The smaller "waste oil" pit was about 0.5 m (18 inches) deep and 9 m (30 feet) wide by 15 m (50 feet) long.

The large pits were operated essentially as a cut-and-fill landfill; as a pit began to fill with rubble, it was covered and another pit was opened. However, the waste was burned every time something was put in the pit. The entire area has now been filled-in and graded. The only evidence of the burn pit area is a surface scar and a mound of unused fill material.

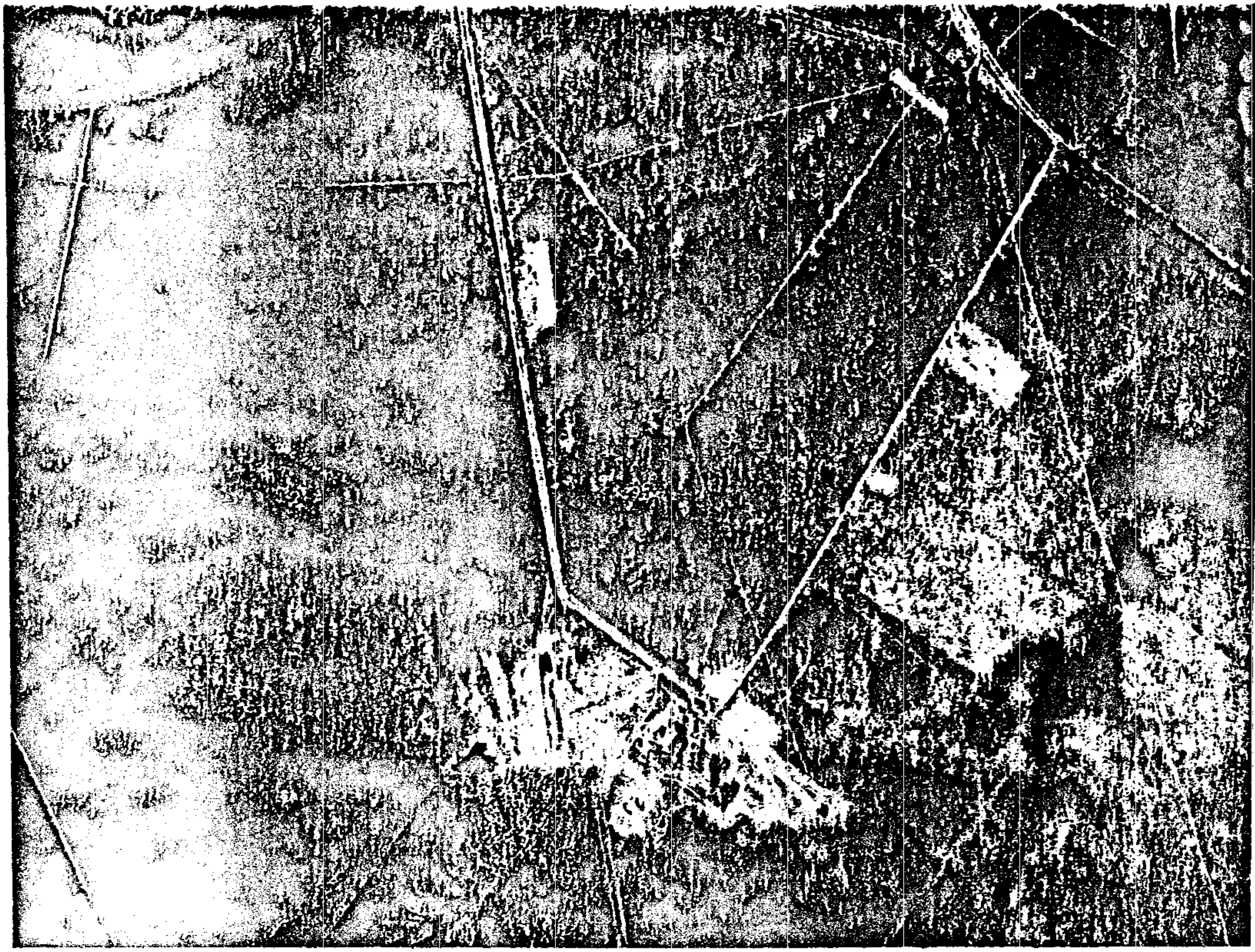

Figure 4.5.2. TAN/WRRTF Burn Pit (1958 to 1966/67) location.

4.5.3.5.2 <u>Wastes Received</u>--This burn pit took all garbage and burnable debris from the TAN area from 1958 to the 1966/67 time frame. From 1958 to about 1961 or 1962, the same pit that was receiving garbage also received waste petroleum products that were generated at TAN. After experiencing some incidents where drums were accidently lost down the pit embankment while dumping, the shallow pit for liquids was excavated. As with the larger pits, the material was set afire each time it was dumped there.

No records were kept of the solids or liquids that received disposal at this site. It is suspected that the petroleum products burned at the pit(s) included such things as:

- Waste fuel oil from boiler operations
- Waste oil from equipment maintenance
- Zinc-bromide oil from the hot shop windows and the alcohol used to clean it out
- Waste Stoddard Solvent from parts cleaning

The quantities of solid and liquid waste that went to these pits are unknown. However, it is estimated that about 950 L (250 gallons) of waste oil and Stoddard Solvent has been generated each year from the Auto Mechanics Shop at TSF. It is also unknown how much of the solid or liquid waste remained after burning, but it is assumed that the burning has decreased the wastes' potential to cause migration problems.

The hazardous constituents that went to the WRRTF burn pits appear to be limited to those liquids described above. It is possible that small quantities of janitorial cleaning materials may have gone to the pits but there is no evidence that any significant streams of chemical wastes were involved.

4.6 ARA Past Activity Review

4.6.1 ARA Description

The Auxiliary Reactor Area (ARA)[a] is broken into four main areas where various activities have been performed from 1955 to present. The four areas are ARA-I, ARA-II, ARA-III, and ARA-IV.

The ARA is located in the south-central part of the INEL. Originally, access to the ARA was from U.S. Highway 20, and approximately one mile north on Fillmore Blvd. During 1984, this direct access road was closed and barracaded, so that present access is through the INEL South Guard Facility.

4.6.1.1 ARA-I Description. ARA-I is the furthest south of the four ARA areas. It has two main buildings, initially constructed about 1957 to support the Stationary Low Power Reactor No. 1 (SL-1) which was located at what is now called ARA-II. Figure 4.6.1 presents the plot plans for ARA-I.

Building ARA 626 is a hot cell building, presently used to support materials research. It also contains a small laboratory area for sample preparation and inspection; this laboratory is presently not used.

Building ARA 627 was a print shop from about 1955 to 1971. During 1971, this building was expanded and modified to serve as a research laboratory for materials development and testing. In 1980 the building was further modified to incorporate a radiochemistry laboratory. During 1984, this building became unoccupied, with the exception of the radiochemistry laboratory, which is still being used.

Other facilities located at ARA-I are ARA 629, a pump house which provides potable water and fire water, stored in Tank 727; the guard house, ARA 628; a fuel storage tank, Tank 728; and a hot-waste storage tank, Tank 729.

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a. This area was originally called the ARMY Reactor Area, which became the Auxiliary Reactor Area in 1965 when the ARMY's program was phased out.

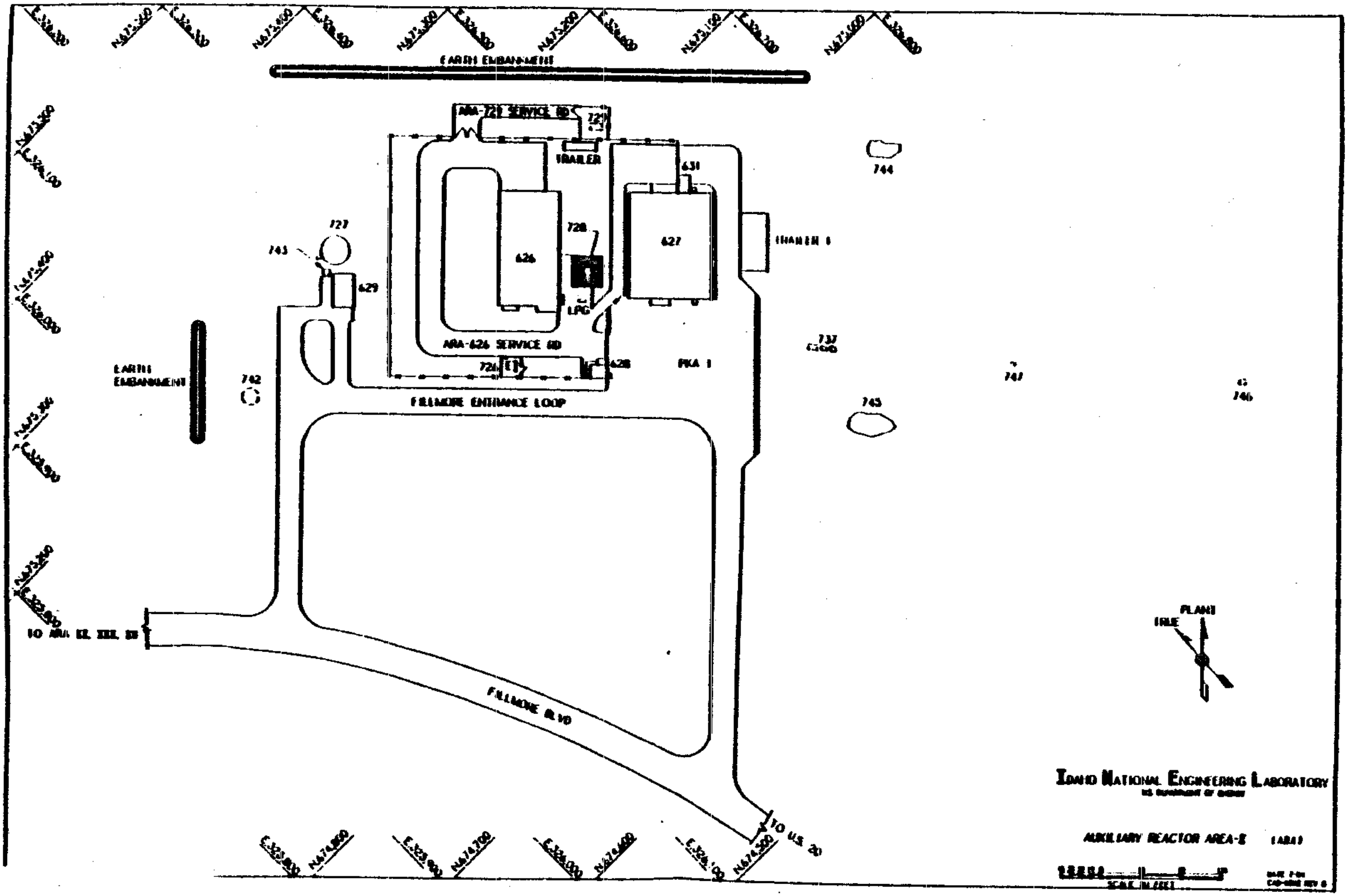


Figure 4.6.1. ARA-I plot plan.

4.6.1.2 ARA-II Description. ARA-II was originally the site of the Stationary Low Power Reactor No. 1 (SL-1) which was a prototype 300 kw (thermal) electrical power (200 kw) and heat source intended for use at remote military bases. The reactor was operated from August 1958 until December 23, 1960. During completion of maintenance operations on January 3, 1961, a nuclear excursion and explosion occurred. Cleanup operations were completed 18 months later during which time a fenced 4.6-acre burial ground was established about 1600 feet northeast of ARA-II; more than 3000 yd^3 of radioactive waste, including the reactor, were buried there. Blacktop was placed over the entire 350-ft by 375-ft ARA-II area within the perimeter fence to stabilize the area. Following the cleanup, the three main buildings were converted to offices and welding shops.

The buildings and structures that make up ARA-II are: The guardhouse, ARA 604; the administration building ARA 613; two 3900-ft^2 buildings, ARA 602 and 606; the power extrapolation building, ARA 615; the decontamination and layout building, ARA 614; and numerous utility buildings and components including the electrical power substation, 701; the wellhouse ARA 601; water storage tank, 702; chlorinator building, ARA 605; fuel oil tanks (an aboveground 1400-gal tank and an underground 1000-gal tank); underground waste storage and drainage components (a 1500-gal septic tank, 738; two 500 gallon septic tanks, and a 1000 gallon radioactive waste detention tank), telephone and light poles and lines, and a mobile home trailer that was brought in after the SL-1 accident. Figure 4.6.2 presents the plot plan for ARA-II.

4.6.1.3 ARA-III Description. ARA-III was originally built to house the ARMY Gas Cooled Reactor Experiment (GCRE) which was designed, fabricated, and tested at the INEL. Construction was completed in 1959 and test work was continued until April 1, 1961, when the plant was deactivated (1962). The major test equipment consisted of a gas circulation system (blowers, heaters, heat exchangers, and a water cooling loop) to release

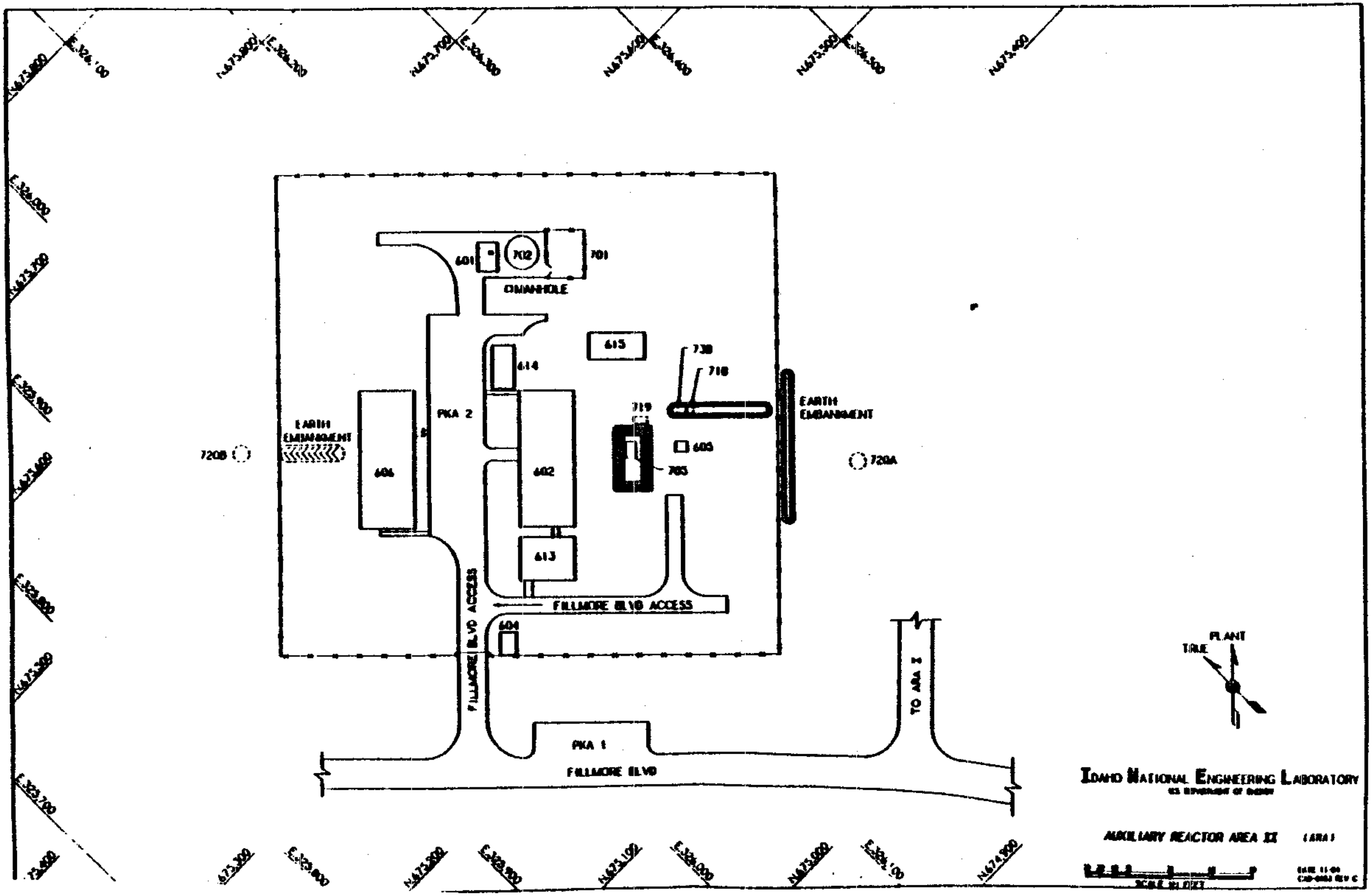


Figure 4.6.2. ARA-II

reactor heat (2.2 MW) to the atmosphere through a cooling tower. The GCRE was a water-moderated, nitrogen-cooled, direct-and-closed-cycle reactor that generated heat, but no electricity.

During 1963, the reactor building and control room were modified for testing of the ML- reactor. In late 1965, the ARMY Reactor Program was phased out.

Originally, the buildings consisted of: ARA 608, the reactor building; ARA 607, the reactor control building: ARA 610 and 622, shop and storage buildings; ARA 612, nuclear materials storage bunker; and ARA 609, the guardhouse. In 1969, ARA 630 and ARA 621 were built to provide additional laboratory and office space. There is a small mobile trailer, T-1, which is used for electronic equipment storage.

In addition, the site has several storage tanks, as shown in Figure 4.6.3 (ARA-III plot plan); presently, only 709 (the water storage tank) and 710 (the fuel oil storage tank) are being used.

4.6.1.4 <u>ARA-IV Description</u>. The ARA-IV facility was designed to accommodate the Mobile Low Power Plant No. 1 reactor, a portable, gas-cooled, water moderated power reactor. This project was in operation from 1957 through May 29, 1964. From mid-1967 to June 1970 a small Nuclear Effects Reactor (FRAN) was operated on the site before its removal to Lawrence Livermore Laboratory. The area was closed down until 1975 at which time it was used temporarily for some welding qualification work. In 1984 and 1985 the facility underwent D&D. Presently, the facility (due to its remoteness) is being used to perform some explosive-initiated powdered-metal manufacture experiments. Only two buildings remain, ARA 617 and a part of ARA 616. There are three leach pits at ARA-IV. Leach Pit 1 was used for radioactive wastes, and Leach Pits 2 and 3 were used for sanitary wastes for ARA-616 and ARA-617, respectively. Figure 4.6.4 presents the ARA-IV plot plan.

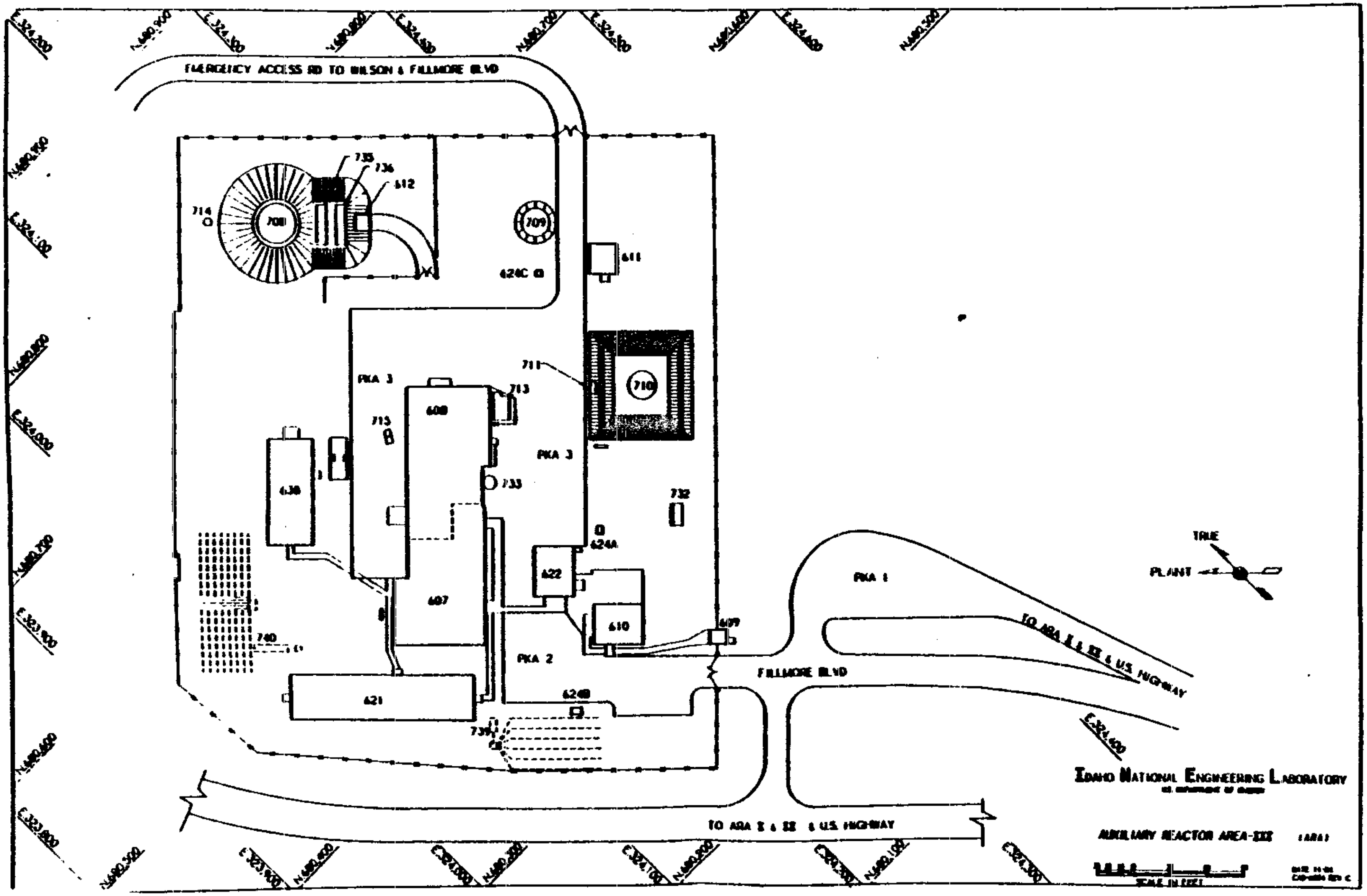


Figure 4.6.3. ARA-III Plot Plan.

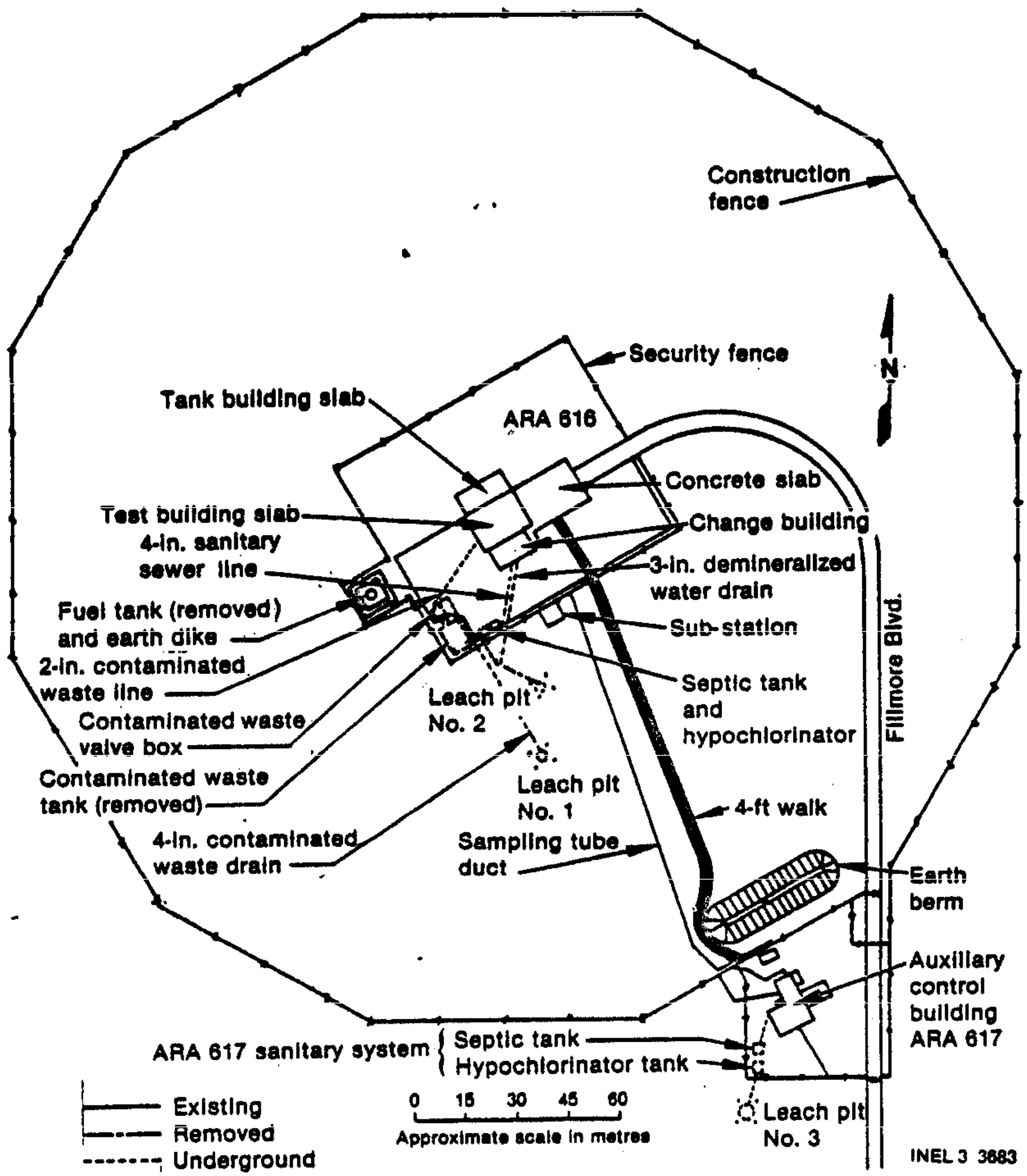


Figure 4.6.4. ARA-IV Plot Plan.

4.6.2 ARA Wastes Generated by Specific Activity

Through the investigation of reports on past activities, interviews with past and present personnel assigned to ARA, and through site tours, a list of hazardous waste constituents and approximate quantities has been drawn up for the ARA. This list is presented in Table 4.6.1. Those facilities which are not now, nor have in the past, generated any significant quantities of hazardous waste are omitted from this table. The facilities identified in Table 4.6.1 are discussed in the following paragraphs.

4.6.2.1 ARA-I. The hot cells, ARA 626 (ARA-I), have been in operation since 1957. They were originally used to support operations for the ARMY's Nuclear Reactor Program conducted at ARA. In 1965, all activities in support of the ARMY's program were curtailed at ARA, and activities in the hot cell were dedicated to other programs at the INEL. In 1970, the operation of the hot cell became dedicated to Fuels and Material research, but this had no significant impact on the quantity or type of work at the hot cell. The hazardous chemicals used at the hot cell were limited to small quantities of solvents and acids.

Typically, because of the personnel hazards associated with these chemicals in a hot cell environment, soap and water were the cleaning agents of choice. When organic solvents were used, either methanol or acetone was used because of their high vapor pressures. Occasionally, nitric acid was used in the hot cell laboratory. The effluents generated during these operations were passed through a hot sewer to a radioactive holding tank. Periodically, this tank was emptied and the contents shipped to ICPP for processing and disposal. Contaminated radiation worker clothing and rags, either contaminated or moistened with cleaning fluids, were originally sent to the RWMC. More recently, these articles, if not contaminated with TRU waste, have been sent to WERF prior to disposal at the RWMC.

TABLE 4.6.1. AUXILIARY REACTOR AREA FACILITIES WASTE GENERATION

Shop Location	Function	Waste Stream	Time Frame	Estimated Quantities (if known)	Treatment/Storage/Disposal
ARA-626 (ARA I)	Hot Cells	Degreasing waste	1957-present		Idaho Chemical Processing Plant (ICPP)
		Mixed radioactive			
		Soap/water		100 l/yr	
		Acetone		5 l/yr	
		Methanol		5 l/yr	
		Chlorinated/parafine		5 l/yr	
		Metal etching wastes	1957-present		
		Mixed acids		<5 l/yr	ICPP
		Rags/Radiation clothing	1957-present	300 lb/yr	RWMC & WERF
ARA-627 (ARA I)	Print Shop	Rags/cleaning	1957-1970	300 lb/yr	Landfill
		Acetone/printing fluids		20 lb/yr	Landfill
	Materials Development & Testing	Metal etching fluids			
		Mixed radioctive (HNO_3)	1970-1984	20 l/yr	ICPP
		Non-radioactive (HNO_3)	1976-1984	20 l/yr	Chemical Leach Field
		Solvents			
		Acetone, Methanol	1970-1984	20 l/yr	Chemical Leach Field
	Radiochemistry Lab	Lightly contaminated solvents ($\sim 1 \times 10^{-12}$ Ci/ml) Xylene, Heptane, 2-ethyl hexanol, Methanol	1980-present	12 l/yr (total)	Chemical Leach Field

TABLE 4.6.1. (continued)

Facility Location	Function	Waste Stream	Time Frame	Estimated Quantities	Treatment/Storage/Disposal
ARA 606 (ARA II)	Welding qualification	Rags/cleaning acetone/MeOH	1962-present	20 l/yr	Landfill
ARA 602 (ARA II)	Welding qualification	Rags/cleaning acetone/MeOH	1962-1984	20 l/yr	Landfill
ARA 621 (ARA III)	Chemical research	Mineral acids	1980-1983		Septic Tank
		HNO_3	1980-1983	5 l/yr	ARA-740
		H_2SO_4	1980-1983	5 l/yr	ARA-740
		HCl	1980-1983	5 l/yr	ARA-740
		Solvents	1980-1983		ARA-740
		di-methyl sulfoxide	1980-1983	.25 l/yr	ARA-740
		methanol	1980-1983	10 l/yr	ARA-740
		ethanol	1980-1983	1 l/yr	ARA-740
		2-propanol	1980-1983	1 l/yr	ARA-740
		acetone	1980-1983	1 l/yr	ARA-740
		methylene chloride	1980-1983	1 l/yr	ARA-740
		3-chloroethane	1980-1983	1 l/yr	ARA-740
		toluene	1980-1983	100 ml/y	ARA-740
		chlorobenzene	1980-1983	100 ml/y	ARA-740
		Metals (dissolved salts)			
		chromium	1980-1983	50 g/y	ARA-740
		boron	1980-1983	50 g/y	ARA-740
		strontium	1980-1983	50 g/y	ARA-740
		zirconium	1980-1983	50 g/y	ARA-740
ARA 630 (ARA III)	Geochemical Research	Mineral Acids	1980-1982		Septic Tank
		H_2SO_4	1980-1982	1 l/yr	ARA-740
		HNO_3	1980-1982	1 l/yr	ARA-740
		Potassium chromate	1980-1982	1 l/yr	ARA-740
		acetone	1980-1982	1 l/yr	ARA-740

Building 627 (ARA-I) was originally a print shop which generated small amounts (approximately 300 lb/yr) of rags which were occasionally wetted with acetone/printing fluids. These rags were disposed of in a land-fill.

During 1970, Building 627 was modified and expanded and subsequently used for materials research and testing. From 1970 to 1984, small amounts of organic solvents and mineral acids were used in operations in Building 627. Typically, but infrequently, when large amounts of acids or solvents were used on a specific project, they were retained and sent to TRA or ICPP for disposal. The small amounts of acids and solvents which were used on a more routine basis (metal etching, cleaning, etc.) were disposed of in the following manner. Acids which were radioactively contaminated (from metal etching operations) were put into the radioactive waste sewer and retained in the radioactive waste tank (the same tank used by Building 626). These wastes were subsequently treated and disposed of at ICPP when the tank was periodically emptied. Nonradioactively contaminated acids and solvents were disposed of in a chemical leach field located south of Building 627.

In 1980, minor modifications were again made to this building to provide space for a radiochemistry laboratory. This laboratory performs extractions to determine potential leaching of radionuclides from waste forms and other inorganic media. By the nature of the work performed, approximately 95 to 99% of the low-level radioactivity contained in the analytical samples is retained on filter paper, and periodically sent to the RWMC. The minor amounts of radioactivity which are not captured during extraction operations (approximately 1×10^{-12} Ci/mL) and the organic solvents used in the extraction process (xylene, heptane, 2-ethyl hexanol, and methanol) are sent to the chemical leach field.

In 1984, the materials research and testing operations were moved from Building 627, and presently the only work being performed in the building is in the radiochemistry laboratory.

4.6.2.2 ARA-II. ARA-II originally housed the Argonne Low Power Reactor (ALPR) PLant, which was later renamed as the Stationary Low Power Reactor No. 1 (SL-1). This reactor operated from March 1958 to December 1960. On January 3, 1961, near the completion of routine maintenance and minor modifications to this reactor, a nuclear excursion occurred. Cleanup operations began in April 1961 and were completed in November 1962. Following cleanup, the three main buildings (ARA 602, 606, and 613) were used as office and welding shop space.

Building 606 has housed the INEL welding qualification program since that time. Building 602 was used for welding research until 1984, when the research was moved into the Idaho Laboratory Facility (ILF). Presently Building 602 is used to warehouse some welding equipment. Building 613 was used to supply office space to the welding program and some PBF personnel; Building 613 was also vacated in 1984.

Due to the nature of the work performed (nonradioactive welding), very few hazardous materials were employed. The only materials used were small amounts of solvents, methanol, acetone, chlorinated hydrocarbons, etc., which were used for cleaning metal parts prior to welding. These solvents were used with rags and the rags were subsequently sent to a landfill. A conservative estimate of the quantity of solvents used is 20 L/yr (total of all solvents). There is no evidence of any significant spill of these solvents.

4.6.2.3 ARA-III. The ARA-III facility was initially constructed (1958-1959) for development and experimental testing of the ARMY Gas-Cooled Reactor (AGCR). The reactor was subsequently operated from February 1960 through April 1961. During normal operation of this reactor, a small amount of low-level radioactive material was released into a portion of the closed loop water cooling system. This small amount of contamination was diluted by significant amounts of cooling water. This water was collected in ARA-708, a 75,000-gallon low-level wastewater storage tank, sampled, and then drained into a leach field located across Fillmore Blvd., due west of

ARA-III. Analysis of the leach field indicates an above-anticipated chromium content in the soil, which was probably due to drainage of water from a cooling tower (removed in 1966); dichromate solutions were typically used to prevent algal growth in cooling tower waters. There is also some evidence of low levels of radioactive contamination in this leach pond. This pond will be discussed in Section 4.6.3.

In 1962, the AGCR project was terminated. In 1963, the reactor was modified for testing of the ML- reactor. This reactor was intermittently operated from April 1964 to September 1965. During this period, several leaks were encountered, which resulted in radioactive silver (108) being released into the leach field. In late 1965, the ARMY Reactor Program was phased out. Since that time, no radioactive research has been performed at ARA-III.

Since 1966, the ARA-III facility has been used primarily as a component and instrumentation laboratory for testing and evaluation of items to be used later in nuclear reactor experiments. No known chemically hazardous or radioactively contaminated materials were used in these experiments.

In 1969, two new buildings, ARA-621 and ARA-630, were built to provide additional office and laboratory space. The laboratory, ARA-630, was used primarily for instrumentation development, fabrication, and testing. There is no evidence of hazardous materials being used for this work.

During the period from 1980 through 1983, some chemical research was performed in ARA-621, and some geochemical research performed in ARA-630. Table 4.6.1. lists the hazardous materials used or generated at ARA-III, the disposition of these materials, and the approximate quantities of these materials.

During 1984, essentially all the previous activities were moved from ARA-III. There is one experiment (instrumentation) still being performed at ARA-III. For a period from 1984 through early 1985, ARA-610 was used to evaluate some components from Three Mile Island (TMI). There is no evidence that any contaminated materials from these evaluations escaped from ARA-610 or were disposed of at ARA-III.

4.6.2.4 ARA-IV. The ARA-IV facility originally was used to test the Mobile Low Power Plant No. 1 (ML-) reactor. This was a portable gas-cooled, water-moderated power reactor. The reactor operated from March 1961 to late 1963. During late 1963 and early 1964, the ML- was moved to ARA-III for continuation of the testing program.

In mid-1967, a new program was started at ARA-IV to test a small, pulsed reactor capable of providing bursts of high intensity fast neutrons and gamma radiation. This reactor was operated from August 1968 to June 1970. At that time, ARA-IV was closed down. All utilities were terminated, and tanks, machinery, and electrical equipment were either abandoned or moved to other facilities.

In 1984 and 1985, decontamination and decommissioning (D&D) activities were performed at ARA-IV. Presently, ARA-IV is being used to perform explosive sintered metal forming tests. There are no effluents from these tests. The D&D activities have been completed with the exception of clean-up of Leach Pit No. 1. This leach pit is a 9-ft. diameter, concrete-lined pit with a 20-in. gravel bed for drainage. Soil samples have been collected from the bottom of this leach pit and analyzed for radioactive constituents. Table 4.6.2 lists the results of this analysis.

TABLE 4.6.2. LEACH PIT NO. 1 (ARA-IV)

Species	Concentration (pCi/g)
Cobalt (60)	735 ± 9
Silver (108)	11.63 ± .09
Strontium (90)	0.41 ± .08
Uranium (238)	1.52 ± .05
Uranium (234 & 233)	7.8 ± .2
Uranium (235 & 236)	0.176 ± .008

4.6.2.5 ARA Fuels/Petroleum Management. Fuel storage at ARA-I is limited to No. 2 Fuel Oil which is used to heat Bldgs. 626 and 627. This fuel oil is stored in Tank 728, located between the two buildings. There is no evidence of a significant spill from this tank.

Fuel storage at ARA-II is limited to No. 2 Fuel Oil which is used to heat buildings within the area. Building 606 is supplied oil from a buried 1000-gal tank located just northwest of the building. Buildings 602 and 613 are supplied fuel oil from Tank 705, a 1400-gal aboveground tank located southeast of Bldg. 692. There is also a buried 1000-gal detention tank located just off the northeast edge of the berm surrounding Tank 705. This tank contains radioactively contaminated fuel oil which was intentionally drained into the tank during the SL-1 cleanup operation.

Fuel storage at ARA-III is provided by a 42,000-gal tank which stores No. 2 Fuel Oil. This tank provides fuel for the buildings within the ARA-III area, and also serves as bulk storage for the other ARA areas. There is no evidence of any significant spill from this tank.

ARA-IV's fuel storage tank was removed when the facility was shut down in 1966.

4.6.2.6 Spills within the ARA. Review of Unusual Occurrence Reports, personnel interviews, Health Physics records, and site observations provided information on the spills identified in this section.

On January 3, 1961, a nuclear excursion and explosion occurred at SL-1, ARA-II. Cleanup operations took approximately 18 months. During these operations, a burial ground was established about 1600 feet northeast of ARA-II. This burial site is fenced and encompasses about 4.6 acres. More than 3000 yd^3 of highly contaminated materials, including the SL-1 reactor vessel, are buried in this site.

Originally, the ARA-II grounds were covered with topsoil (clean) and then covered with blacktop. Over the years since 1962, there has been significant weathering of this blacktop which has resulted in the migration of radioactive contamination to the surface, and undoubtedly downward from local surface groundwater movement. In addition to the known soil contamination, there is considerable contamination present in the tanks and buildings within the ARA-II fence. A thorough discussion of the contamination at ARA-II and the areas outside the ARA-II fence (including the SL-1 burial ground) can be found in the report, "Characterization and Decision Analysis for the Auxilary Reactor Area II of the Idaho National Engineering Laboratory, PT-Wm-84-010."

Although not documented, there were several occasions during the operation of ML- (1963-1965), ARA-III, when radioactive silver was spilled within the ARA-III grounds. The identification of contaminated equipment and levels of soil contamination associated with these incidents is thoroughly discussed in the report, "Characterization and Decision Analysis of the Auxilary Reactor Area-III of the Idaho National Engineering Laboratory, PG-WM-84-011."

In 1979 a considerable source of radiation was discovered under an office trailer, which has since been relocated, but which was then located just south of ARA-627 (ARA-I). There is no record of how this contamination occurred. There is also indication that the biological waste septic system for this building, located southeast of ARA-627 is contaminated. It is possible that both of these contamination incidents occurred during the cleanup of SL-1; ARA-1 was used as a staging area for the SL-1 cleanup operation.

There is no evidence to indicate any hazardous chemical spills occurring at the ARA areas.

4.6.3 ARA Waste Disposal Sites

Areas or sites within the ARA at which hazardous wastes may have been deposited at some time are discussed in the following paragraphs.

4.6.3.1 Chemical Waste Pond (ARA-745). The chemical waste pond for ARA-627, ARA-I, is designated ARA-745. This pond was installed in 1971 when ARA-627 was expanded. Table 4.6.1 identifies the waste streams introduced into this pond. During the period from September 1981 to May 1984, the flow into this pond was routinely sampled and analyzed for trace metals and radioactivity. Unfortunately, the samples were collected from liquid entering the pond and not from the pond itself. Therefore, unless a sample coincidentally was taken while a chemical was being introduced into the pond, the type and level of contamination would go undetected. The water analyses indicate no unusual chemical species when compared with the water analysis of the well water entering the building, with the exception of chlorine, which would be anticipated. Due to the sampling procedures used for this pond, it is doubtful that the available analytical data accurately represents the pond's condition.

4.6.3.2 Sanitary Waste Leach Field (ARA-I). The sanitary leach field for ARA-I is located east of ARA-627; the area maps do not designate a number for this leach field. Although there are no recorded spills or incidents which would have contaminated this leach field, Health Physics surveys have indicated that it is radioactively contaminated. It is possible that this contamination is a remnant of the SL-1 cleanup operations.

4.6.3.3 ARA-III Pond. The ARA-III Pond was built to receive low-level radioactively contaminated water generated during operation of the GCRE and ML- reactors. Although this pond has not been used for waste materials since the conclusion of the ML- program (1965), a small amount of water still flows into this pond. Attempts to turn off this flow have been unsuccessful without turning off all water to ARA-III.

Soil samples have been collected from the pond; soil samples were limited to the edge of the pond and were not collected from the drainage portion of the pond, which was under water at the time of sampling. Soil samples were analyzed for radionuclides and trace metals. Table 4.6.3 presents a composite of these samples.

TABLE 4.6.3. ANALYSIS OF ARA-III POND SOIL

Species	Concentration mg/kg	Activity pCi/g
Antimony	<10.0	--
Arsenic	2.4	--
Beryllium	1.0	--
Cadmium	0.6	--
Chromium	7.0	--
Copper	19.0	--
Lead	3.4	--
Mercury	<0.005	--
Nickel	14.0	--
Selenium	<0.2	--
Silver	<2.0	
Silver (108)		1.9 - 6.8
Thallium	<2.0	--
Zinc	76.0	--
Boron	<30.0	--
Chloride	<20.0	--
Cyanide	<0.2	--
Nitrogen (Nitrate)	5.0	--
Sulfate	<50.0	--
Phenol	<0.5	--
Cobalt (60)	--	3.1 - 36.9
Cesium (137)	--	0.84 - 4.1

Inspection of these data indicates that the only chemical species which is higher than might be anticipated is chromium. This is probably from the dichromate solutions used to inhibit algal growth in the cooling tower used for GCRE and ML-. The low-level radioactive contamination is also from the GCRE and ML- reactor; the radioactive silver, which was used in the moderators and in various seals for these reactors, was the results of gas leaks in the reactors.

4.6.3.4 SL-1 Burial Ground. This burial ground is discussed in Section 4.6.2.6.

4.6.3.5 Evidence of Migration. There are insufficient numbers of aquifer sampling wells located at the ARA areas to determine whether there has been any significant migration of contamination to the aquifer as a result of operations at ARA. Due to the limited use of the ponds at ARA, and the semi-arid environment, it can be assumed that a significant migration has not occurred.

4.7 PBF Area Past Activity Review

4.7.1 PBF Area Description

The Power Burst Facility (PBF) area is located in the south central portion of the INEL, about six miles northeast of CFA, in an area originally constructed for the Special Power Excursion Reactor Tests (SPERT). The four SPERT reactors were built beginning in the late 1950's as part of an early investigation involving reactor transient behavior tests and safety studies on water-moderated, enriched-fuel reactor systems. All of the reactors have been removed and most of the SPERT facilities have since undergone partial or complete decontamination and decommissioning (D&D).

The last of the SPERT reactors was placed on standby status in 1970 and the PBF began operation just to the north of the SPERT-I reactor around 1972. The PBF was built to support the Thermal Fuel Behavior Program's testing on pressurized-water reactor fuel rods under normal and off-normal operating conditions and hypothetical reactor accidents. The PBF testing program was completed in 1985. The SPERT-III facility now houses the Waste Experimental Reduction Facility (WERF), and the SPERT-IV facility is being modified to become a storage facility for radioactive mixed waste.

As shown in Figure 4.7.1, the PBF area consists of five sites: PBF Control Area, PBF Reactor Area (includes SPERT-I), SPERT-II, SPERT-III, and SPERT-IV. The four reactor areas are arranged in a semicircle around the PBF Control Area with a radius and nominal distance between reactors of one-half of a mile. More detailed descriptions of each of the five sites within the overall PBF area are provided below, along with current facility maps.

4.7.1.1 PBF Control Area Description. A plot plan of the current PBF Control Area is shown in Figure 4.7.2. Though it has been greatly expanded for the PBF program, its main functions have not changed since serving as the SPERT control center. The facility provided for remote operation of

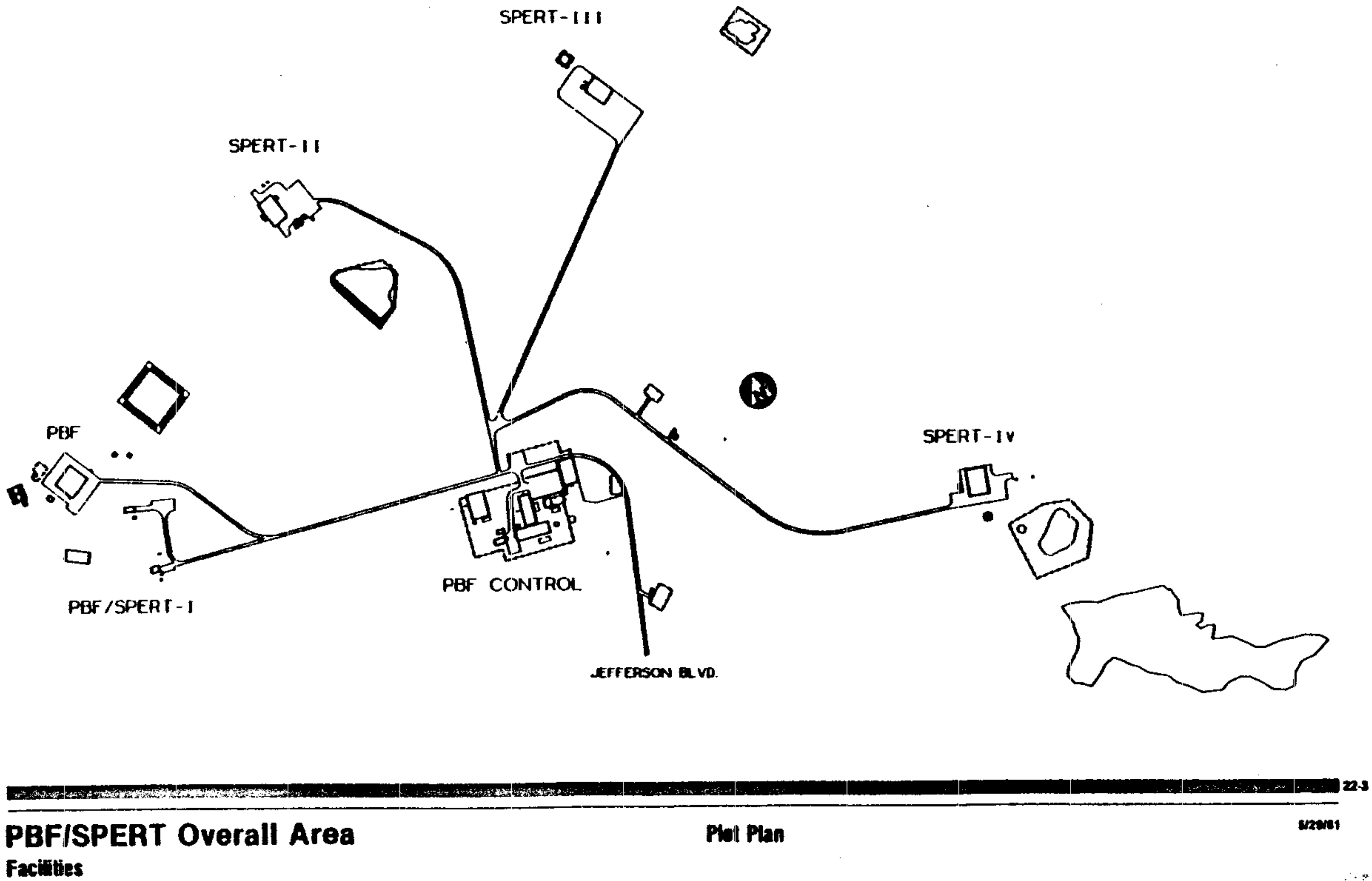


Figure 4.7.1. PBF Overall Area

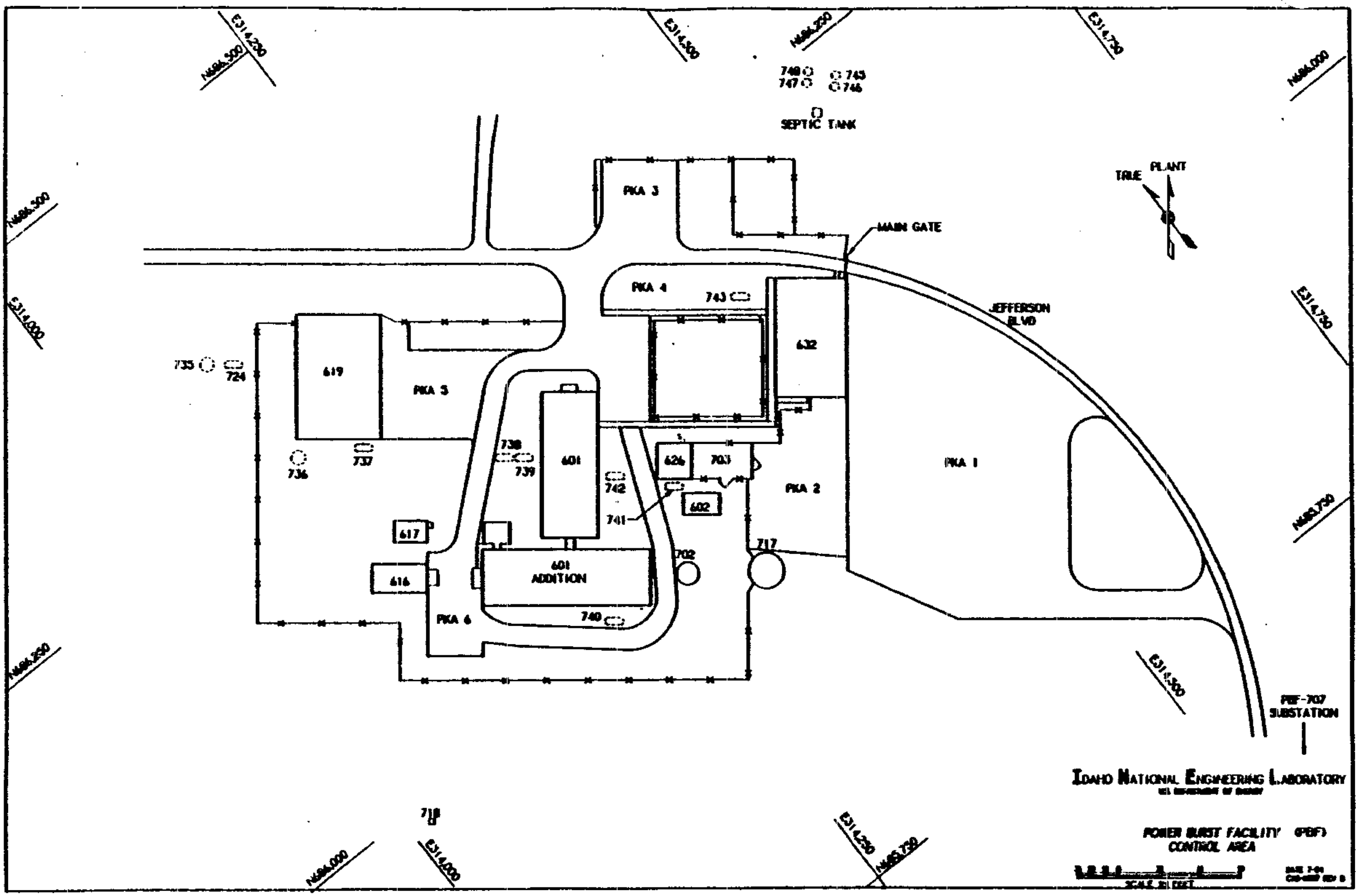


Figure 4.7.2. PBF Control Area

all reactors, raw water storage and distribution, administrative offices, instrument and mechanical work areas, and data acquisition. Due to the nature of these functional duties, no hazardous and/or radioactive wastes have been generated here.

4.7.1.2 PBF Reactor Area Description. The PBF Reactor Area, shown in Figure 4.7.3, includes the reactor areas for both the SPERT-I and the PBF facilities. The structures utilized for SPERT-I are located in the lower right corner of the plot plan and include the reactor pit building (PBF-605), the instrument bunker (PBF-606), the terminal building (PBF-604), and a seepage pit (PBF-750). Another seepage pit, not shown in Figure 4.7.3, was located about 40 ft north of PBF-605 and was D&D'd by EG&G in September 1984.

The SPERT-I reactor was an open, pool-type reactor located below grade in a steel-lined pit in PBF-605, which had no provisions for heat removal or coolant circulation through the core. During the period 1955 to 1964, as many as five tests per day were run to measure the extent and effect of reactor excursions to high power over short periods. The early tests were conducted in a 3,600 L (950 gal) capacity reactor vessel that was placed inside the pit tank. However, beginning in 1962, a series of destructive tests were conducted on various cores using the pit tank as the reactor vessel, which had a capacity of 36,000 L (9,400 gal).

The PBF reactor, housed in PBF-620, achieved criticality in 1972 and was used to study the behavior of fuel rods under a variety of conditions until February 1985. Major components of the PBF reactor system include a 120,000 L (32,000 gal) open tank reactor, an 83,000 L (22,000 gal) canal for temporary storage of reactor fuel and test fuel assemblies, a central flux region containing a cylindrical in-pile tube in which the test fuel is isolated, and various coolant systems. In addition to PBF-620, the other structures in Figure 4.7.3 that are pertinent to this report are the cooling towers (PBF-720), the auxiliary building (PBF-624) where the

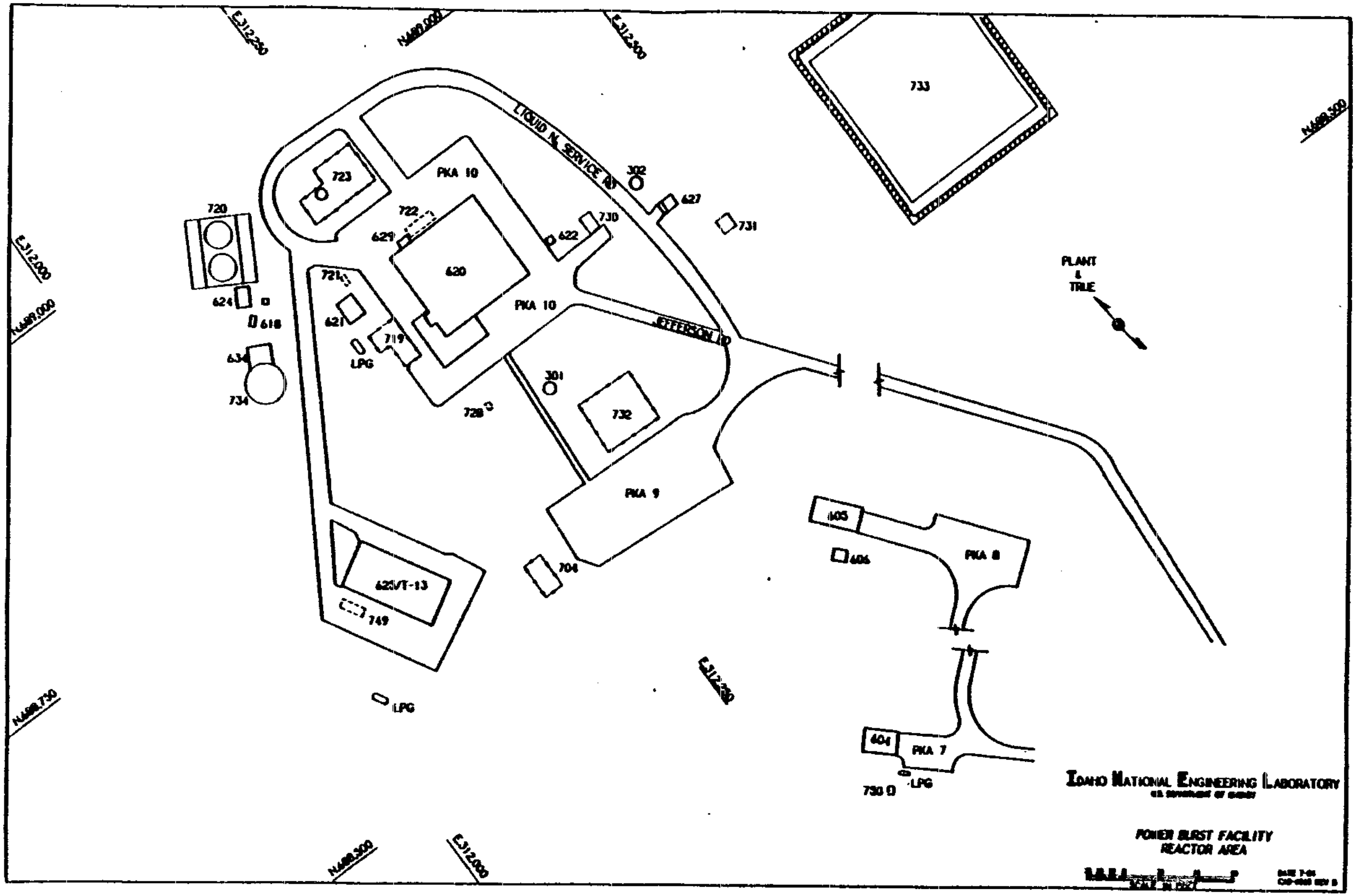


Figure 4.7.3. PBF Reactor Area.

secondary cooling water is chemically treated, the hot waste storage tank (PBF-732), the warm waste injection well (PBF-301), the corrosive waste injection well (PBF-302), the corrosive waste disposal sump (PBF-731), and the corrosive waste evaporation pond (PBF-733).

4.7.1.3 SPERT-II Area Description. The present-day SPERT-II facility, shown in Figure 4.7.4, has not changed much since the period from 1960 to 1964, when the SPERT-II pressurized-water reactor was operational. The original facility did, however, include a 45,000 L (12,000 gal) demineralized water storage tank just to the east of the reactor building (PBF-612) that has since been removed. Also, a 190,000 L (50,000 gal) hot waste storage tank (PBF-751) was installed, ca. 1982, to supplement PBF's hot waste storage capability.

The SPERT-II reactor was designed to operate with either light or heavy water as moderator and coolant, and was utilized to determine the transient characteristics of heavy water-moderated reactors, the parameters that affected these characteristics, and the differences between light and heavy water-moderated reactors. Power operation was not an objective in the design of the facility since the tests were conducted from low initial reactor powers and involved relatively small total energy releases. As a result, no provision was made for heat removal other than an outdoor, forced-air heat exchanger for cooling the heavy water coolant after shutdown. Due to its expense, an extensive heavy water cleanup and recovery system was housed in PBF-612 so that the heavy water could be saved and reused.

4.7.1.4 SPERT-III Area Description. A current plot plan of SPERT-III is provided in Figure 4.7.5, which shows the modifications that have been incorporated to accommodate the WERF project. these modifications include expansion of the SPERT-III reactor building (PBF-609) and addition of the sizing and decontamination building (PBF-635). The original SPERT-III facility also used to include the following structures that are not shown in Figure 4.7.5: an underground, 30,000 L (8,000 gal) hot waste storage

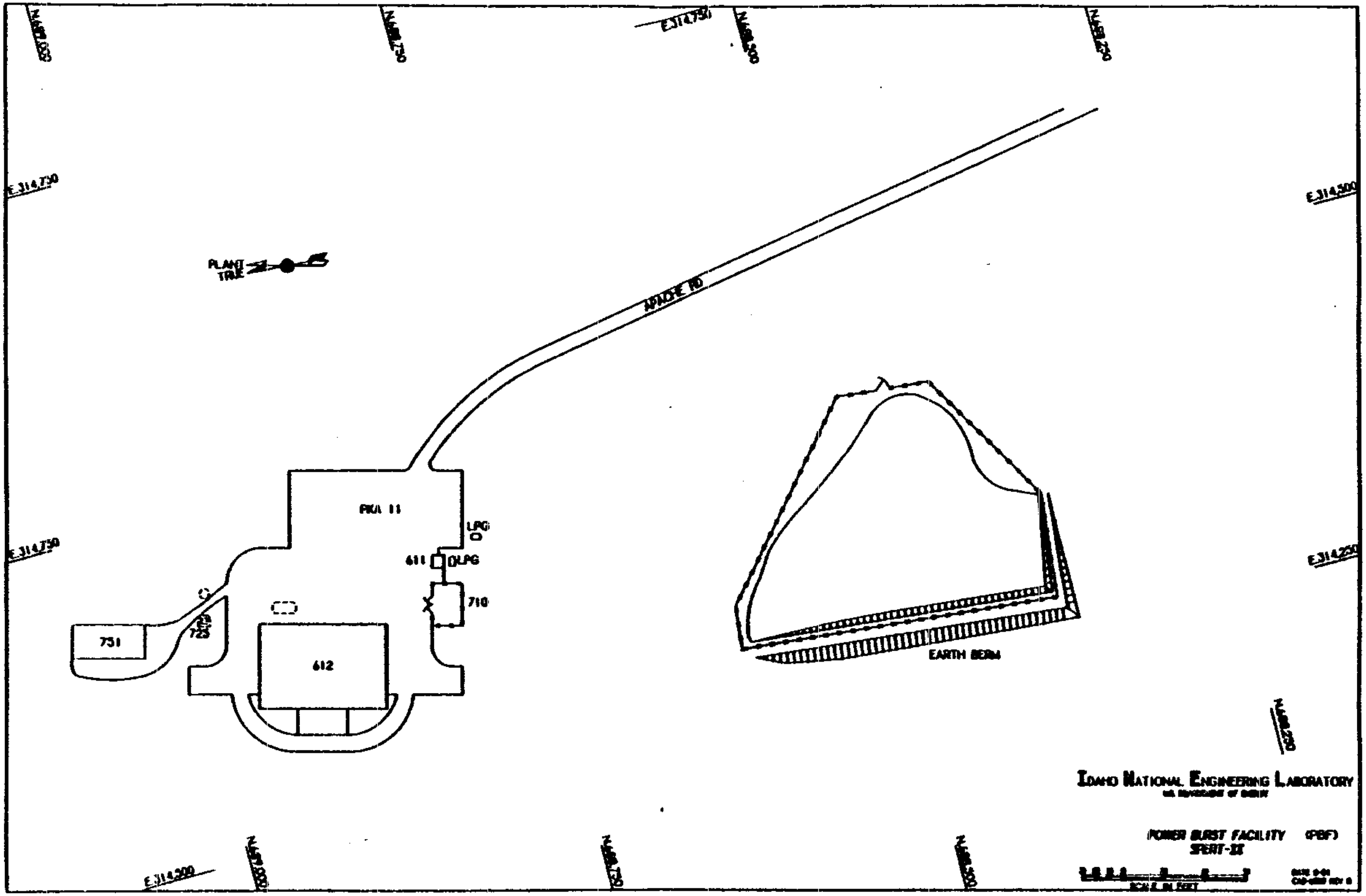


Figure 4.7.4. SPERT-II Area

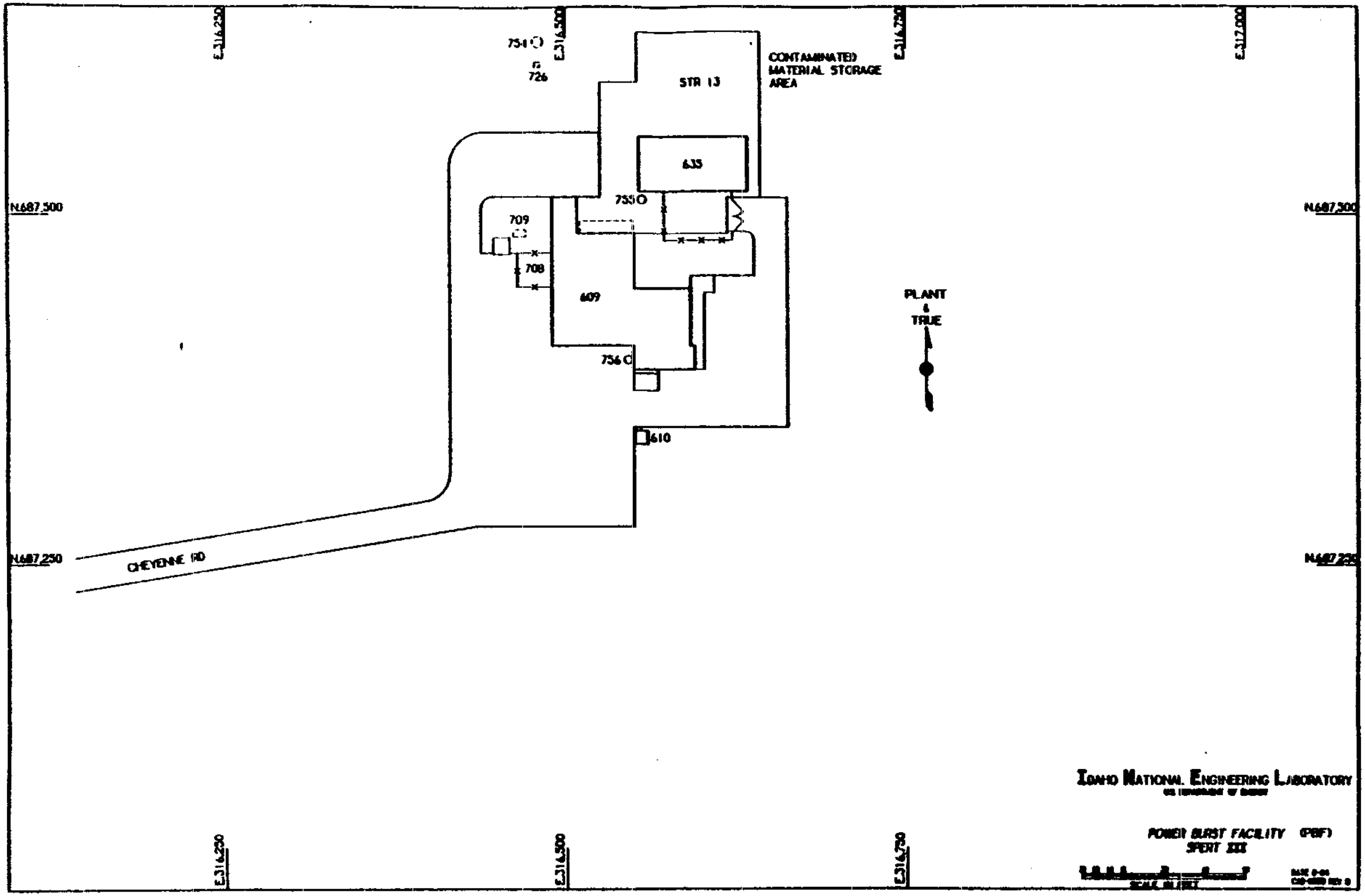


Figure 4.7.5. SPERT-III Area.

tank just to the west of PBF-609, a 45,000 L (12,000 gal) demineralized water storage tank north of PBF-609, a small leach pond just to the east of the septic tank (PBF-726), and a larger leach pond 122 m (400 ft) southeast of PBF-609. The former locations of the ponds can be seen in Figure 4.7.1.

The SPERT-III pressurized-water reactor operated from 1958 to 1968 and was used to determine the effect of water flow, pressure, and temperature on transient reactor characteristics. Most of the tests were conducted from low initial reactor powers and involved small total energy releases. However, power operation for a limited time (about 30 min) was also provided for by circulating the primary coolant through heat exchangers, where the heat was rejected to the secondary coolant.

Following D&D of the reactor building in 1980, construction was started on the WERF project. WERF began operation in 1982 and is involved in the volume reduction of low-level radioactive wastes. This is accomplished by using a controlled-air incinerator and a 680-kg (1500-lb) capacity melter located in PBF-609, and the metal-sizing and decontamination facilities housed in PBF-635.

4.7.1.5 <u>SPERT-IV Area Description</u>. The SPERT-IV area, shown in Figure 4.7.6, is essentially the same as it was during the period from 1961 to 1970, when the reactor was operational. The major structures within the area are the reactor building (PBF-613), the 231,000 L (61,000 gal) capacity hot waste holdup tank (PBF-714), and the leach pond (PBF-758). In addition, the larger leach pond, called the "SPERT-IV Lake," was located south of PBF-758 and had a capacity of about 23 million L, or 6 million gal (see Figure 4.7.1), and was used to dispose of nonradioactive, untreated cooling water.

The SPERT-IV reactor building housed two 190,000 L (50,000 gal) reactor pool tanks; one for nuclear testing and one for hot fuel storage. Studies conducted here included the effect of power excursions and instability tests at conditions typically found in large, open-pool type

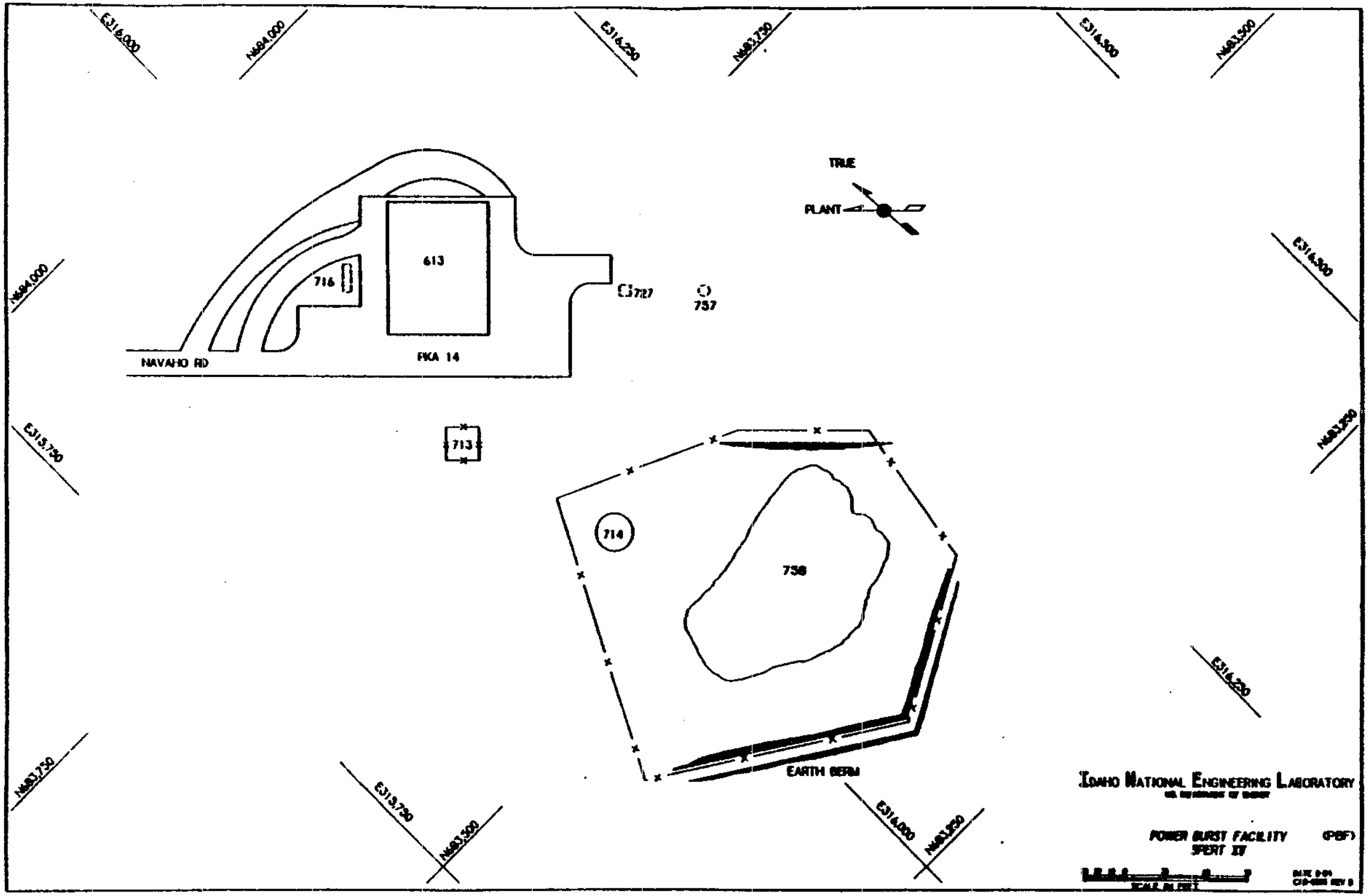


Figure 4.7.6. SPERT-IV Area.

reactors. Power operation for a limited time was provided for by circulating the demineralized primary coolant water through a heat exchanger, where the heat generated in the reactor core could be rejected to the waste secondary coolant water.

4.7.2 PBF Area Wastes Generated by Activity

The wastes generated from past activities conducted at the individual sites within the overall PBF area are discussed in this section. Since no hazardous materials were used and no hazardous wastes were produced at the PBF Control Area, it is not addressed further. A summary of the findings obtained from past reports, interviews, and site visits is given in Table 4.7.1. This table provides the pertinent information, where known, on the composition, quantity, period of generation, and disposal method for the potentially hazardous wastes generated at the PBF area.

Also included in this section are the management of fuels/petroleum and the spills of significance that have occurred since 1976 within the overall PBF area.

4.7.2.1 PBF Reactor Area.

4.7.2.1.1 SPERT-I--The terminal building, PBF-604, housed the service facilities for SPERT-I including a zeolite softener and a mixed-bed demineralizer. This water treatment system produced the only significant quantities of chemical wastes at SPERT-I during regeneration of the ion exchange resins. Regeneration of the the demineralizer was necessary after treating 25,000 L (6,700 gal) of water and required about 15 kg of sulfuric acid and 25 kg of sodium hydroxide. The corrosive solutions produced during regeneration were discharged without neutralization to the seepage pit (PBF-750) south of PBF-604. Due to the lack of information on the frequency of regenerating the demineralizer, a rough estimate of ten times per year was assumed after conferring with former operators.

Shop Location	Function	Waste Stream	Time Frame	Estimated Quantities (if known)	Treatment/Storage/Disposal
PBF-604 (SPERT-I)	Demineralization Plant	Sulfuric acid (ion exchange regenerant)	1955-1964	150 kg/yr	SPERT-I corrosive waste seepage pit
		Sodium hydroxide (ion exchange regenerant)	1955-1964	250 kg/yr	SPERT-I corrosive waste seepage pit
PBF-605 (SPERT-I)	Reactor Building cleanup	Rags with trichloroethane, trichloroethylene, ethanol, carbon tetrachloride	1955-1964	Small	RWMC
PBF-620 (PBF)	Demineralization Plant	Sulfuric acid (ion exchange regenerant)	1972-1978	1,300 kg/yr	PBF corrosive waste injection well (PBF-302)
			1979-1984	1,200 kg/yr	PBF evaporation pond (PBF-733)
			1984-present	--	Neutralized prior to release
		Sodium hydroxide (ion exchange regenerant)	1972-1978	1,500 kg/yr	PBF corrosive waste injection well (PBF-302)
			1979-1984	1,300 kg/yr	PBF evaporation pond (PBF-733)
			1984-present	--	Neutralized prior to release
	Cleanup of water in reactor vessel, canal, and loop	Spent ion exchange, resins--no regeneration	1972-present		RWMC
	Decontamination of sampling system	TURCO 4502 (caustic plus potassium permanganate)	1984-present	8 kg/yr	ICPP
		TURCO 4521 (oxalic acid)	1984-present	4 kg/yr	ICPP
	Equipment maintenance	Waste hydraulic oil	1972-present	750 L/yr	CFA

Shop Location	Function	Waste Stream	Time Frame	Estimated Quantities (if known)	Treatment/Storage/Disposal
PBF-624 (PBF)	Pretreatment of secondary coolant	Trivalent chromium	1972-1978	17 kg/yr	PBF corrosive waste injection well (PBF-302)
		Trivalent chromium	1979-1984	15 kg/yr	PBF evaporation pond (PBF-733)
PBF-612 (SPERT-II)	Demineralization Plant	Sulfuric acid (ion exchange regenerant)	1960-1964	40 kg/yr	SPERT-II leaching pond
		Sodium hydroxide (ion exchange regenerant)	1960-1964	70 kg/yr	SPERT-II leaching pond
PBF-609 (SPERT-III)	Demineralization Plant	Sulfuric acid (ion exchange regenerant)	1958-1968	400 kg/yr	SPERT-III small leaching pond
		Sodium hydroxide (ion exchange regenerant)	1958-1968	700 kg/yr	SPERT-III small leaching pond
PBF-609 (WERF)	WERF off-gas treatment	Flyash containing Cd, Cr, Pb	1984-present	6 55-gal drums	Stored outside of PBF-635
PBF-613 (SPERT-IV)	Demineralization Plant	Sulfuric acid (ion exchange regenerant)	1961-1970	800 kg/yr	SPERT-IV leaching pond (PBF-758)
		Sodium hydroxide (ion exchange regenerant)	1961-1970	1,000 kg/yr	SPERT-IV leaching pond (PBF-758)

Cleanup operations were occasionally required in the reactor building (PBF-605) that involved organic solvents such as trichloroethane, trichloroethylene, and smaller amounts of ethanol and carbon tetrachloride. However, according to former operators, these materials were not released to the warm waste seepage pit, but applied by hand with rags which were sent to the RWMC for burial.

4.7.2.1.2 PBF--The demineralization plant in PBF-620 consists of two mixed-bed demineralizers that were regenerated after treating about 57,000 L (15,000 gal) each. Regeneration involved successive flushes with sulfuric acid, sodium hydroxide, and about 3,000 gal of rinse water. These corrosive solutions were drained to a common 12,000 gal sump (PBF-731) where they were neutralized by mixing. From 1972 to 1978, wastes containing an average of 1,500 kg/yr of sodium hydroxide and 1,300 kg/yr of sulfuric acid were pumped from the sump and discharged into the corrosive waste injection well (PBF-302). Since 1979, these wastes have been sent to the corrosive waste evaporation pond (PBF-733) and have contained an average of 1,300 kg/yr of sodium hydroxide and 1,200 kg/yr of sulfuric acid. The pH of the sump effluent has been monitored prior to release since late 1984 and has usually been between 6.5 and 7.0. Prior to that the pH was not checked. However, since the method of disposal has not been changed, it is likely that previous releases were also nonhazardous.

Other wastes generated in PBF-620 include disposable ion-exchange resins that are used to maintain water purity in the reactor vessel, canal, and experimental loop. These resins are sent to the RWMC for burial when depleted. Also, waste TURCO solutions (TURCO 4521 and TURCO 4502) are generated about once a year since 1984 during decontamination of the sampling system. These wastes are sent to ICPP for treatment, along with the other hot wastes generated at PBF. Lastly, about 750 L (200 gal/yr) of waste hydraulic oil have been generated during the maintenance of mechanical equipment in PBF-620 and other buildings. This waste oil was stored in 55-gal drums on a concrete pad just north of PBF-625 (see Figure 4.7.3) and then transferred to CFA.

The raw water used in the secondary coolant system is pretreated in the auxiliary building (PBF-624). In addition to the relatively minor amounts of sulfuric acid used here to maintain the pH of the secondary coolant between 7.0 and 8.0, corrosion inhibitors were also added that contained hexavalent chromium. The chromate concentration was maintained at about 15 to 20 ppm. The secondary coolant system was drained periodically (2 to 4 times per year) and the amount of chromates disposed at the PBF were recorded in the Industrial Waste Management Information Service (IWMIS) reports. As with the discharge from the regeneration of the demineralizers, the waste secondary coolant was released to the corrosive waste injection well from 1972 to 1978 and then rerouted to the evaporation pond until 1984, when PBF switched to a nonhazardous phosphate-based corrosion inhibitor. The IWMIS reports indicate that, on the average, 38 kg/yr of chromate ions (17 kg/yr trivalent chromium) were discharged to the injection well and 33 kg/yr (15 kg/yr trivalent chromium) to the evaporation pond. It should be noted that the chromium in the coolant was reduced to trivalent chromium by bubbling sulfur dioxide through it before being released.

The secondary coolant is passed through cooling towers (PBF-720) to reject heat transferred from the primary coolant. There is no blowdown stream from PBF-720, but the water vapor released to the atmosphere from the towers may contain low concentrations of chromium. Since 1979, cooling tower evaporation losses have averaged about 3.4×10^6 L/yr from PBF-720. However, since most of the chemical additives are expected to remain in the water and since any releases are dissipated over an unconfined area, no estimate has been made on the chemical loss via cooling tower evaporation.

4.7.2.2 SPERT-II. A demineralization plant that consisted of a zeolite softener and a mixed bed demineralizer was located in the SPERT-II reactor building (PBF-612). Regeneration of the demineralizer was necessary after processing 38,000 L (10,000 gal) of soft water and required 20 kg of sulfuric acid and 35 kg of sodium hydroxide. The resulting corrosive solutions were piped directly to the SPERT-II leach pond located about 91 m (300 ft) south of the reactor building.

Because the SPERT-II reactor primarily used heavy water as coolant, a rough estimate of only two demineralizer regenerations per year has been assumed. This number was confirmed by former operators at the SPERT-II facility.

4.7.2.3 SPERT-III. As with the other SPERT facilities, the SPERT-III facility also had a demineralization plant to supply deionized water to the reactor. The water treatment system was housed in PBF-609 and included a zeolite softener and a mixed-bed demineralizer. The demineralizer had a treatment capacity of 75,000 L (20,000 gal) between regenerations, which required 40 kg of sulfuric acid and 70 kg of sodium hydroxide. The successive acidic and caustic rinses were piped directly (no neutralization) to the small corrosive waste leach pond 30 m (100 ft) north of PBF-609.

According to former operators, the demineralizer was regenerated about ten times a year. However, it should be noted that this and, therefore, the quantities given in Table 4.7.1 are only rough estimates.

Since about 1982, the SPERT-III facility has been used to house the WERF project. The principal wastes generated at WERF (bottom ash and slag) are nonhazardous and sent to the RWMC for burial. However, the flyash and particulate matter removed from the baghouse filter are handled as hazardous waste because of their heavy metal content. Six 55-gal drums of flyash have been generated to date and are being stored in a metal dumpster within a restricted area north of PBF-635 until the radioactive mixed waste storage facility is available at SPERT-IV. Liquid wastes are not generated by WERF and both SPERT-III leach ponds have been backfilled and seeded.

4.7.2.4 SPERT-IV. The SPERT-IV demineralization plant, located in PBF-613, consisted of a zeolite softener and two mixed-bed demineralizers. Corrosive wastes produced during regeneration of the demineralizers were directed to the SPERT-IV leach pond (PBF-758) located about 270 ft south of the reactor building (PBF-613). No attempt was made to neutralize these solutions prior to release.

The two demineralizers had a combined capacity of 114,000 L (30,000 gal) per regeneration. A total of 80 kg of sulfuric acid and 100 kg of sodium hydroxide was required to regenerate the ion exchange resins in both units. Assuming that regeneration was done, on the average, ten times a year the quantities given in Table 4.7.1 were obtained. Once again, it should be noted that these numbers are only rough estimates.

4.7.2.5 PBF Area Fuels/Petroleum Management. Table 4.7.2 provides an inventory of the fuel/petroleum storage tanks within the overall PBF area. Bulk fuels used at PBF are limited to No. 2 diesel fuel for generators, No. 2 fuel oil for boilers, and one currently used tank for gasoline. All tanks are buried outside and are refilled by tank truck.

The maintenance of mechanical equipment within the PBF area generates relatively small quantities of waste hydraulic oil. This waste oil is accumulated in drums which are stored on a concrete pad just north of PBF-625. From there they are transferred to the CFA for ultimate recycling by an off-site vendor.

4.7.2.6 Spills Within the PBF Area. Review of UOR's, personnel interviews, and site visits were used to obtain information on any significant spills occurring within the overall PBF area. The findings are summarized below.

In December of 1974, the 1,000-gal hot waste storage tank in the basement of the PBF reactor building (PBF-620) was filled beyond capacity and some contaminated liquid was released to the basement floor. The radioactive water was collected in the warm waste sump and shipped to the ICPP.

In April 1976, about 5 gal of contaminated water were released to the ground during the transfer of hot liquid waste from the storage tank to the tank truck. The small section of contaminated asphalt was removed and taken to the RWMC for disposal.

4.7.2. PBF AREA FUEL/PETROLEUM STORAGE TANKS

Location	Oil Type	Maximum Capacity (g)	Underground (U), Outside (O), Inside (I)	Level Check	IMMS #	Responsibility	Comments
Control Area:							
PBF-742	No. 2 fuel oil	4,000	U, O	Automatic refill	--	Plant Services	--
PBF-740	No. 2 fuel oil	2,000	U, O	Automatic refill	--	Plant Services	--
PBF-737	No. 2 fuel oil	2,000	U, O	Automatic refill	--	Plant Services	--
PBF-741	Diesel No. 2	500	U, O	Automatic refill	--	Plant Services	--
PBF-743	No. 2 fuel oil	2,000	U, O	Automatic refill	--	Plant Services	--
Reactor Area:							
--	--	--	U, O	Dipstick	--	--	Abandoned-east side of PBF-605; pumped dry
PBF-722	No. 2 fuel oil	10,000	U, O	Automatic refill	--	Plant Services	--
PBF-721	Gasoline	265	U, O	--	--	--	--
PBF-749	Diesel No. 2	5,000	U, O	Automatic refill	--	Plant Services	--
SPERT-II:							
PBF-752	No. 2 fuel oil	6,000	U, O	Dipstick	--	Plant Services	--
--	Gasoline	--	U, O	--	--	--	Abandoned; pumped dry
SPERT-III:							
PBF-709	No. 2 fuel oil	3,000	U, O	Dipstick	--	--	--
SPERT-IV:							
PBF-716	No. 2 fuel oil	2,000	U, O	Automatic refill	--	Plant Services	--

In April 1978, while sluicing depleted, radioactively contaminated resin from the reactor and canal cleanup system, the resin catch tank ruptured. A small amount of contaminated water leaked out of the secondary containment and onto the truck bed, which was decontaminated.

Another contaminated water spill occurred in October of 1979 while transferring hot waste from the 1,000-gal indoor storage tank to the 10,000-gal outdoor storage tank. Approximately 10 gal of hot waste were spilled on the asphalt at the truck loading station. The asphalt was removed and disposed at the RWMC.

A similar spill occurred while filling the 5,000-gal tank truck for transfer of hot waste to the ICPP in July 1980. The contaminated truck exterior and pavement beneath it were cleaned up and no special problems were encountered.

In January 1983, 10 square inches of cadmium-plated metal was processed along with 1,300 lb of stainless steel in the WERF melter in PBF-609. Exposure to cadmium vapor and dust was found to be minimal and new procedures were instituted to screen out similar metals from feeds going to the melter in future operations.

In December of 1983, the piping to the 50,000-gal hot waste storage tank (PBF-751) at SPERT-II froze and about 200 gal of contaminated water were released to the ground. The free-standing liquid was pumped back into the tank and the low-level contamination was cleaned up.

4.7.3 PBF Area Waste Disposal Sites

Areas or sites within the overall PBF area at which hazardous and/or radioactive wastes may have been released are discussed in this section. Those sites which were found to be connected with hazardous waste disposal are summarized in Table 4.7.3.

TABLE 4.7.3. PBF AREA HAZARDOUS WASTE DISPOSAL SITES

Site	Site Name	Period of Operation	Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Wastes	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
PBF-750	SPERT-I corrosive waste seepage pit	1955-1964	64	Sulfuric acid Sodium hydroxide	1,350 kg 2,250 kg	Discharge to open, unlined seepage pit	Has not been used since 1964	Snake River Plain Aquifer is about 139 m below surface which is generally level. Subsurface consists of alternating layers of basalt and silt.	No specific action taken to exclude surface drainage from reaching pit	None
PBF-302	PBF corrosive waste injection well	1972-1978	N/A	Sulfuric acid[a] Sodium hydroxide[a] Trivalent chromium	9,100 kg 10,500 kg 119 kg	Discharged to common sump then to shallow injection well	Closed--well plugged	Same	Well head is beneath paved road excluding surface drainage	None
PBF-733	PBF evaporation pond	1979-present	2,400	Sulfuric acid[a] Sodium hydroxide[a] Trivalent chromium	7,200 kg 7,800 kg 90 kg	Discharged to common sump then to hypalon-lined pond	Active--Discharge of hazardous chemicals eliminated in late 1984	Same	Pond has bermed sides that exclude surface drainage	None
--	SPERT-II leach pond	1960-1964 1977-present	2,500	Sulfuric acid Sodium hydroxide	200 kg 350 kg	Discharged to open, unlined pond	Active--Has received only nonradioactive, raw cooling water since 1977	Same	Pond is slightly bermed but may not exclude surface drainage	None
--	SPERT-III small leach pond	1958-1968	81	Sulfuric acid Sodium hydroxide	4,400 kg 7,700 kg	Discharged to open, unlined pond	Closed-backfilled and seeded	Same	Area is now flat with no provision to exclude surface drainage.	None
PBF-758	SPERT-IV leach pond	1961-1970	1,750	Sulfuric acid Sodium hydroxide	8,000 kg 10,000 kg	Discharged to open, unlined pond	Active--Has received only "clean" water and minor amounts of radioactive water since 1979	Same	Pond is bermed along 1/2 of its perimeter and may not exclude all surface drainage	None

a. These materials (acids and bases) were at least partially neutralized prior to release.

The groundwater beneath the PBF area has been periodically analyzed by the USGS. Samples have been taken from the production well near the PBF Control Area since 1956. To date, there has been no evidence of any contaminants, chemical or radioactive, reaching the Snake River Plain Aquifer.

4.7.3.1 SPERT-I Corrosive Waste Seepage Pit (PBF-750).

4.7.3.1.1 Description--The SPERT-I corrosive waste seepage pit is located about 15 m (50 ft) south of the terminal building (PBF-604). It is roughly circular in shape with a 9 m (30 ft) diameter at the top and a depth of about 5 m (15 ft). The regional groundwater level is about 139 m (455 ft) below the surface.

4.7.3.1.2 Wastes Received--The SPERT-I corrosive waste seepage pit was used to dispose of nonradioactive, chemical liquid wastes from the water treatment equipment in PBF-604. These wastes included salt solutions produced during the regeneration of a zeolite softener and acidic and caustic solutions produced during the regeneration of a mixed-bed demineralizer. The quantities of sulfuric acid and sodium hydroxide discharged to the pit in Table 4.7.3 were determined by assuming that an average of ten demineralizer regenerations were required per year during the nine-year SPERT-I operating period.

4.7.3.2 SPERT-I Warm-Waste Seepage Pit.

4.7.3.2.1 Description--The SPERT-I warm-waste seepage pit was located about 12 m (40 ft) north of the pit building (PBF-605). The pit basin was approximately 14 m (45 ft) by 5 m (15 ft) and was surrounded by an earthen dike varying from 0.6 (2 ft) to 2 m (6 ft) in height. It was D&D'd by EG&G in September 1984, at which time the top 0.8 m (2.5 ft) of contaminated soil from the pit was removed, along with the underground waste line, and sent to the RWMC. This was followed by backfilling of the seepage pit with radiologically clean soil and seeding with grass.

4.7.3.2.2 Wastes Received--The SPERT-I warm waste seepage pit was designed to receive the low-level waste water pumped from the sump pit in PBF-605. Under normal operating conditions the activity of this waste cooling water was well below the upper limit for direct, surface disposal. Past reports indicate that even during the SPERT-I destructive test series, the activity was low enough to be discharged directly to the seepage pit. However, a detailed characterization of the pit in 1982 revealed that minor releases of fission products had occurred. The D&D radiological survey showed a maximum surface activity of 196 cpm, compared to a background reading of 72 cpm. The principal contaminants were Cs-137, U-234, and U-238. Upon completion of the D&D operations, described briefly in the preceding section, a maximum surface activity of 76 cpm was obtained.

4.7.3.3 PBF Warm-Waste Injection Well (PBF-301).

4.7.3.3.1 Description--The PBF warm-waste injection well, located 25 m (83 ft) south of the PBF reactor building (PBF-620), was drilled in 1969. It is a dry well with a 25.4 cm (10 in.) diameter and a depth of 34 m (110 ft), ending in a natural sump of rock, gravel, and sand. Steel casing extends to the bottom of the well and is perforated between the 22 m (72 ft) and 32 m (105 ft) levels. The depth to the ground-water is 139 m (455 ft). In the summer of 1984 the well was sealed and capped.

4.7.3.3.2 Wastes Received--The warm-waste injection well received low-level radioactive liquid waste from the 5,700 L (1,500 gal) warm-waste sump in PBF-620 from 1973 to 1980. When the radioactivity level in the sump was above the specified level for disposal to the well, the liquid was transferred to the hot-waste storage tanks and ultimately to the ICPP. In addition to the low-activity fluids collected from various floor and equipment drains throughout PBF-620, the injection well was also used to dispose of uncontaminated, raw water used by the utility cooling system for cooling plant equipment.

The quantities and radionuclide content of the low-level wastewater discharged into PBF-301 from July 1973 to August 1980 have been well-documented in the Radioactive Waste Management Information System (RWMIS) reports. During this time, the average annual discharge was about 1.2×10^6 L/y. Table 4.7.4 provides a summary of the radionuclides released to the injection well.

The quantities of uncontaminated, raw cooling water that were also sent to the injection well during this same period (1973 to 1980) averaged about 6.1×10^6 L/y. From 1981 to 1984, this stream was the only one discharged to PBF-301.

4.7.3.4 PBF Corrosive-Waste Injection Well (PBF-302).

4.7.3.4.1 Description--The PBF corrosive-waste injection well was drilled in 1969 in an area 34 m (110 ft) east of the reactor building and about 55 m (180 ft) northeast of the warm-waste injection well (PBF-301). It is 10.2 cm (4 in.) in diameter and 35 m (115 ft) deep. Discharge to the well ceased in mid-1979, and the well was subsequently plugged.

4.7.3.4.2 Wastes Received--The PBF corrosive-waste injection well was used from about 1972 through December 1978 to dispose of uncontaminated chemical wastes. Liquid wastes disposed of here originated from the regeneration of demineralizers and the draining of the secondary coolant system. Beginning in January 1979, these wastes were rerouted to the PBF evaporation pond.

During the seven years that the corrosive-waste injection well was used, an average of 1.1×10^6 L/y of chemical wastewater were discharged to it. The hazardous constituents which were contained in this waste stream are given in Table 4.7.3. It should be noted that the sulfuric acid and sodium hydroxide solutions released to PBF-302 were probably nonhazardous. This is due largely to the fact that the acidic and caustic streams were drained to a common sump and largely neutralized prior to discharge into the well. The wastewater from the secondary coolant system

TABLE 4.7.4. CURIES RELEASED TO PBF-301 (July 1973-August 1980)

Radionuclide	Curies Released	Radionuclide	Curies Released
(Ag) Silver-110	1.069×10^{-3}	(Nb) Niobium-95	1.512×10^{-3}
(Ag) Silver-110M	4.786×10^{-4}	(Np) Neptunium-239	3.395×10^{-3}
(Ba) Barium-140	1.095×10^{-3}	(Ru) Ruthenium-103	1.303×10^{-5}
(Ce) Cerium-141	9.830×10^{-4}	(Ru) Ruthenium-106	3.062×10^{-5}
(Ce) Cerium-143	3.121×10^{-2}	(Sb) Antimony-122	1.257×10^{-5}
(Ce) Cerium-144	2.605×10^{-4}	(Sb) Antimony-124	1.563×10^{-4}
(Co) Cobalt-58	3.499×10^{-3}	(Sm) Samarium-153	3.482×10^{-3}
(Co) Cobalt-60	9.988×10^{-4}	(Sr) Strontium-89	4.717×10^{-3}
(Cr) Chromium-51	8.722×10^{-3}	(Sr) Strontium-90	1.804×10^{-3}
(Cs) Cesium-134	1.230×10^{-2}	Unidentified Alpha	2.218×10^{-4}
(Cs) Cesium-137	3.022×10^{-1}	Unidentified Beta and Gamma	3.287×10^{-2}
(H) Tritium-3	2.107×10^{-2}	(W) Tungsten-187	2.803×10^{-3}
(Hf) Hafnium-181	2.115×10^{-4}	(Xe) Xenon-133	1.448×10^{-2}
(I) Iodine-131	1.116×10^{-2}	(Y) Yttrium-90	1.477×10^{-3}
(I) Iodine-133	3.360×10^{-6}	(Zr) Zirconium-95	4.619×10^{-4}
(La) Lanthanum-140	3.787×10^{-3}		
(Mn) Manganese-54	3.812×10^{-4}		
(Mo) Molybdenum-99	1.048×10^{-2}	Total Curies Released	4.786×10^{-1}

was also shunted through this sump and would have further diluted the corrosive solutions from demineralizer regeneration. However, since the pH of the sump effluent pumped to the well was not measured, the regenerant solutions have been included as hazardous wastes.

4.7.3.5 PBF Evaporation Pond (PBF-733).

4.7.3.5.1 Description--The PBF evaporation pond was constructed in 1978 about 85 m (280 ft) east of the reactor building. The pond was formed from dirt bermed to 1.4 m (4.5 ft) in height with dimensions of 43 x 43 m (140 x 140 ft) at the bottom and 52 x 52 m (170 x 170 ft) at the top. The bottom and sides are layered with 22.9 cm (9 in.) and 7.6 cm (3 in.) of sand, respectively. A 0.08 cm (0.03 in.) thick Hypalon lining is in place over the sand. Depth to the Snake River Plain Aquifer is about 139 m (455 ft).

4.7.3.5.2 Wastes Received--The PBF evaporation pond has been receiving the plant's corrosive and chemical wastes, formerly sent to the injection well (PBF-302), since January of 1979. These include the chromium-containing water drained from the secondary coolant system and the sulfuric acid and sodium hydroxide solutions produced during the regeneration of the demineralizers. As discussed in Section 4.7.3.4, the two streams are routed to the corrosive waste sump and then to the evaporation pond. The combined regenerant solution has once again been listed as a hazardous waste, even though its pH was probably close to neutral.

By the latter part of 1984, the discharge of hazardous chemical wastes to the evaporation pond had been eliminated, as shown in Table 4.7.3. This was accomplished by switching from the chromate-based corrosion inhibitor to a phosphate-based system in the secondary coolant system. Procedures were also instituted to monitor the pH of the sump effluent, which was found to vary between 6.5 and 7.0. Prior to these changes (1979 to 1984), the average annual discharge of hazardous waste water to the PBF evaporation pond was 1.4×10^6 L/yr.

4.7.3.6 SPERT-II Leach Pond.

4.7.3.6.1 Description--The SPERT-II leach pond is located about 91 m (300 ft) south of the reactor building (PBF-612). It is roughly 61 m (200 ft) by 46 m (150 ft) and about 1 m (3 ft) below the surrounding area. The depth to the Snake River Plain Aquifer is about 139 m (455 ft).

4.7.3.6.2 Wastes Received--The SPERT-II leach pond was designed to receive both the chemical wastes from the demineralization plant and the low-level radioactive waste drained from the reactor. The hazardous chemical wastes discharged to the pond consisted of sulfuric acid and sodium hydroxide solutions produced during the regeneration of the mixed-bed demineralizer. However, since the SPERT-II reactor primarily used heavy water as coolant, which was purified and reused, its demineralized (light) water requirements were assumed to be much smaller than those of the other SPERT reactors.

Under normal operating conditions the only radioactive waste disposed to the pond was the primary coolant water drained from the reactor to maintain water purity. As previously mentioned, this occurred only when light water was used and, therefore, the discharge of contaminated liquid waste to the pond should also have been fairly small.

This has been verified by D&D characterizations of the pond in 1982 and 1985. In both radiological surveys the pond was found to be uncontaminated with a surface activity comparable to background.

The only waste currently being released to the pond is clean cooling water used for the air compressor in the PBF maintenance shop, now located in the SPERT-II reactor building. There is no evidence that any additional hazardous wastes have been released by the maintenance shop. An analysis for toxic contaminants in a soil sample from the pond was conducted in 1983 and revealed that the soil would not be classified as hazardous on the basis of EP (Extraction Procedure) toxicity. The results of the analysis are presented in Table 4.7.5.

TABLE 4.7.5. SUMMARY OF TOXIC CONTAMINANT CONCENTRATIONS IN SPERT-II LEACH POND

Contaminant	Concentration in soil (mg/kg)	Equivalent Concentration[1] (mg/l)	EP Toxicity Maximum Concentration (mg/l)
Arsenic	2.9	0.145	5.0
Cadmium	1.2	0.06	1.0
Chromium	7.0	0.35	5.0
Lead	32	1.6	5.0
Mercury	0.71	0.0355	0.2
Selenium	<0.2	<0.0073	1.0
Silver	<2	<0.1	5.0
Endrin	<0.006	<0.0003	0.02
Lindane	<0.006	<0.003	0.4
Toxaphene	<0.06	<0.003	0.5

Notes

1. Soil concentration times 0.05 gives the maximum concentration (mg/l), if all the contaminant present were to pass into solution during the EP toxicity test.

2. Analysis conducted in October, 1983.

4.7.3.7 SPERT-III Small Leach Pond.

4.7.3.7.1 Description--The SPERT-III small leach pond was located 30 m (100 ft) north of the reactor building (PBF-609) and consisted of a 9 x 9 m (30 x 30 ft) gravel pit about 0.6 m (2 ft) below the surrounding area. An underground vitrified clay pipe was used to drain the effluent from the water treatment system. The pond was 139 m (455 ft) above the ground water level.

In 1982, a D&D characterization of the pond was performed. The radiological survey revealed the pond to be uncontaminated and it was then backfilled and seeded with native grasses.

4.7.3.7.2 Wastes Received--The SPERT-III small leach pond was used to dispose of nonradioactive, chemical liquid wastes from the demineralization plant in PBF-609. Primarily, these wastes consisted of sulfuric acid and sodium hydroxide solutions produced during the regeneration of a mixed-bed demineralizer. Salt solutions were also discharged here from regeneration of the zeolite softener.

Since the deactivation of the SPERT-III reactor in 1968, there is no evidence of the pond being used for disposal purposes.

4.7.3.8 SPERT-III Large Leach Pond.

4.7.3.8.1 Description--The SPERT-III large leach pond was located about 122 m (400 ft) southeast of the reactor building (PBF-609). The base of the pond was approximately 15 m (50 ft) by 20 m (65 ft) and was about 2.4 m (8 ft) below the surrounding area. An 8-in. carbon steel discharge line ran underground from the sump pit in PBF-609 to the pond.

In 1982, a characterization of the pond revealed it to be lightly contaminated. Soil samples were found to contain 18 pCi/g of Cs-137, compared to 0.94 pCi/g of Cs-137 for INEL background, and 0.075 pCi/g of

U-235 (versus 0.05 for background). D&D operations, completed in November 1983, involved backfilling the pond with radiologically clean soil and seeding with grass. This reduced the surface activity from a pre-D&D maximum reading of 112 cpm to a maximum of 68 cpm.

4.7.3.8.2 Wastes Received--Under normal operating conditions the only radioactive waste discharged to the pond was the primary coolant water drained from the system to maintain water purity. The activity of this waste water was primarily due to the presence of corrosion an/or erosion products in the water and was usually low enough to permit discharge directly to the pond. A 30,000 L (8,000 gal) hot waste storage tank was available for the collection of highly contaminated waste water but, according to former operators, it was seldom used. Since a separate leach pond was used to dispose of chemical wastes, it is unlikely that any hazardous wastes were discharged to the SPERT-III large leach pond.

4.7.3.9 SPERT-IV Leach Pond (PBF-758).

4.7.3.9.1 Description--Located about 82 m (270 ft) south of the reactor building (PBF-613), the SPERT-IV leach pond is approximately 46 m (150 ft) by 38 m (125 ft) and about 1.5 m (5 ft) below the surrounding area. A 0.6 m (2 ft) high berm of rocks is in place along about one-half of the pond perimeter. The regional groundwater level is about 139 m (455 ft) below the surface.

4.7.3.9.2 Waste Received--The SPERT-IV leach pond was designed to receive both the chemical wastes from the demineralization plant and the low-level radioactive waste drained from the reactor. The chemical wastes produced during the regeneration of the demineralizers (sulfuric acid and sodium hydroxide solutions) were directed to the pond by gravity flow. Table 4.7.3 shows the total quantities of acid and caustic entering the pond that were obtained by assuming that each of the two mixed bed demineralizers were regenerated ten times per year.

Contaminated (radioactive) waste water was flushed into the sump pit in PBF-613. The sump pump discharge line was monitored and when the effluent's radioactive isotope content was more than 50 cpm above background, the waste was piped to a 231,000 L (61,000 gal) hot waste hold-up tank. However, according to former operators, the activity of the waste water was usually low enough to permit discharge directly to the pond. A recently completed (August 1985) radiological survey has shown the surface activity of the pond to be comparable to background readings.

Since the reactor building underwent D&D in February of 1979, it has housed various limited-scale research projects such as waste forms research, plate fuel testing, heat treatment furnace studies and the Three Mile Island core drilling tests. Some of these projects discharged minor amounts of warm waste to the SPERT-IV leach pond, but records do not show any releases of significance. However, in 1982 about 59,000 L (16,000 gal) of contaminated water drained from the PBF primary coolant system were disposed of here when the ICPP could not treat it. The soil contaminated by this discharge was removed and sent to the RWMC.

In 1983, a soil sample from the pond was analyzed for toxic contaminants. The results are presented in Table 4.7.6, which shows that the primary contaminants were chromium and lead. The second column of this table gives the maximum possible concentration obtainable during an EP toxicity test of the soil. Comparing these values to the specified limits for EP toxic wastes, given in column three, reveals that the soil would not be classified as hazardous.

TABLE 4.7.6. SUMMARY OF TOXIC CONTAMINANT CONCENTRATIONS IN SPERT-IV POND

Contaminant	Concentration in soil (mg/kg)	Equivalent Concentration[1] (mg/l)	EP Toxicity Maximum Concentration (mg/l)
Arsenic	<0.5	<0.025	5.0
Cadmium	<0.5	<0.025	1.0
Chromium	5.3	0.265	5.0
Lead	13	0.65	5.0
Mercury	<0.05	<0.0025	0.2
Selenium	<0.2	<0.01	1.0
Silver	<2	<0.1	5.0
Endrin	<0.003	<0.0002	0.02
Lindane	<0.003	<0.0002	0.4
Toxaphene	<0.03	<0.0015	0.5

Notes

1. Soil concentration times 0.05 gives the maximum concentration (mg/l), if all the contaminant present were to pass into solution during the EP toxicity test.

2. Analysis conducted in October, 1983.

4.8 Experimental Organic Cooled Reactor (EOCR) Past Activity Review

4.8.1 EOCR Area Description

The Experimental Organic Cooled Reactor (EOCR) Facility is located approximately 2.5 miles east of the Central Facilities Area. The EOCR project was terminated shortly before completion of construction in September 1962. Because the project was terminated before starting the reactor, no radioactive contamination occurred; therefore, most equipment has been removed for use elsewhere.

The EOCR was designed and built to advance the Organic Reactor program, which addressed coolant and fuel element technology for advanced organic concepts. The Site operating contractor at the time was Phillips Petroleum Company. The reactor was designed to operate at power levels up to 70 MW. Complex cooling systems were built to circulate and cool a paraffin-like organic substance, which in turn cooled the reactor.

During the construction period, operating personnel continued to work toward final occupancy and operating of the EOCR by preparing plant operating manuals and by performing plant system tests. Prior to the project termination, work was in progress on the following systems: Pressurized cooling water system, steam systems, plant and instrument air systems, reactor complex cooling systems, reactor instrumentation, health physics, and radiation monitoring instruments and process instruments. The systems listed (and some additional ones) were completed as part of the EOCR decommissioning.

In 1978-1979, the office portions were used during the demolition of the Organic Moderated Reactor Experiment (OMRE) Facility, which was directly to the south. Since 1978, the facility has been used only for material storage, security force practice maneuvers, occasional explosives testing, and for PBF fuel rod drive.

4.8.1.1 Waste Disposal System Description. Waste disposal included sump discharge, process waste, and sanitary waste. Aqueous waste from the reactor area, canal, and all drains (except those in the laboratory floors, boiler room floors, and utility floors) flowed by gravity to a 5,000-gal concrete sump located below the basement, as shown in Figures 4.8.1 through 4.8.3. Two sump pumps, with a capacity of 250 gpm each, pumped the aqueous waste from the building sump to an aqueous leaching well. The aqueous waste system provided for separate disposal for the acids and caustics resulting from demineralizer regeneration.

The sanitary drain system included collection of discharge from restrooms in a percolation pond.

4.8.2 EOCR Wastes Generated by Activity

According to one source, for a period of two years prior to the decommissioning of EOCR, the demineralized beds were regenerated periodically with sulfuric acid and sodium hydroxide. This effluent was discharged to a nearby leaching pond, as shown in Figure 4.8.4. Between the regular regenerations with sulfuric acid, the beds were also regenerated with zeolite. This was done to provide analytical data for OMRE.

Because the steam system was tested as part of the preparations for plant performance, the boilers were used continually. As a result, the boilers were blown down occasionally and the blowdown contained phosphates and sulfates; these waste streams were also discharged to the leaching pond.

4.8.2.1 Waste Generated by EOCR After Shutdown. From 1965 to 1966, PBF conducted some control and transient rod driven tests at EOCR. These tests provided information concerning the engineering performance of the machinery; therefore, no fuels were involved.

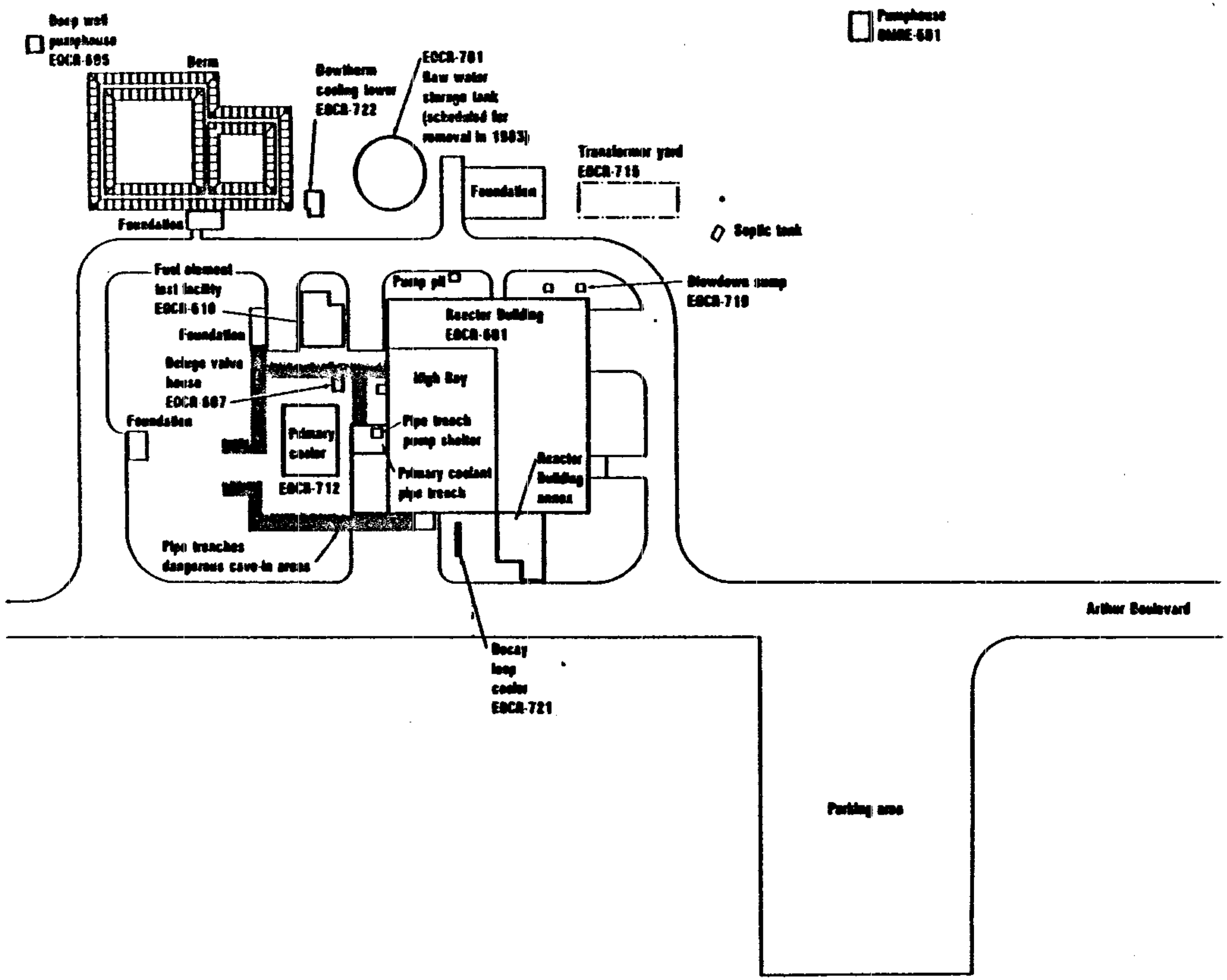


Figure 4.8.1 EOCR plot plan.

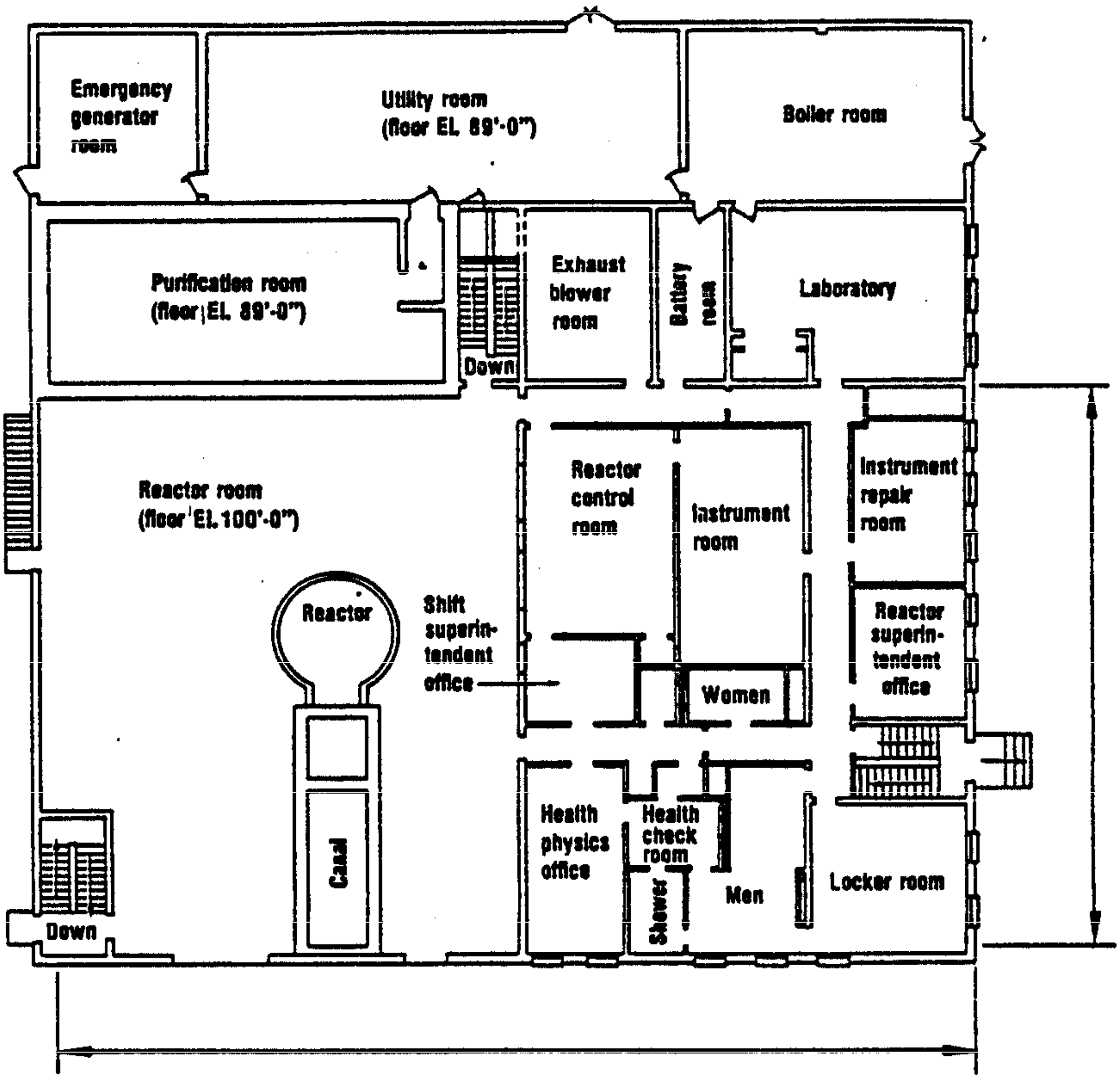


Figure 4.8.2 The main floor of the Reactor Building, EOCR-601.

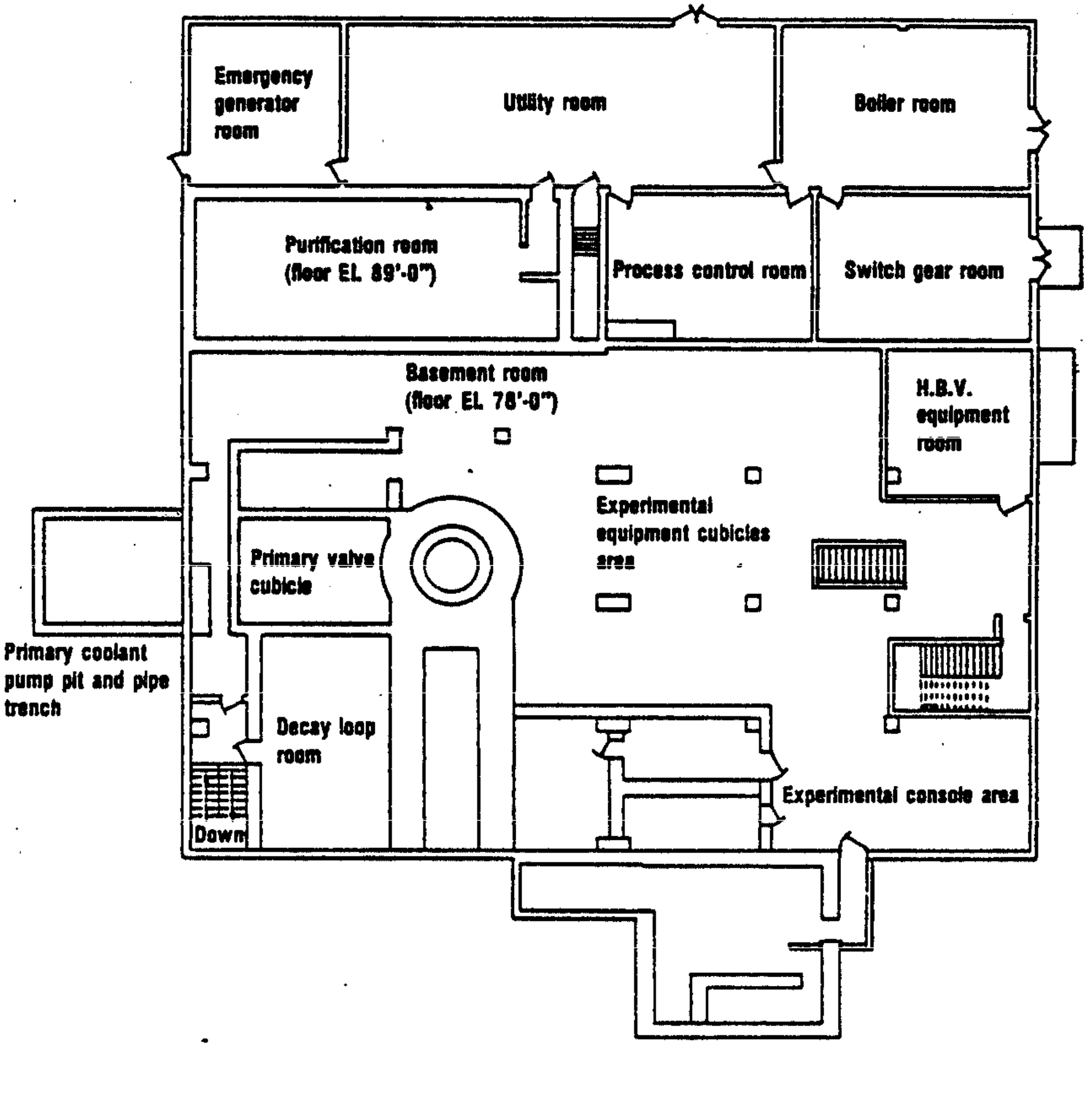


Figure 4.8.3 The basement area of the Reactor Building, EOCR-601.

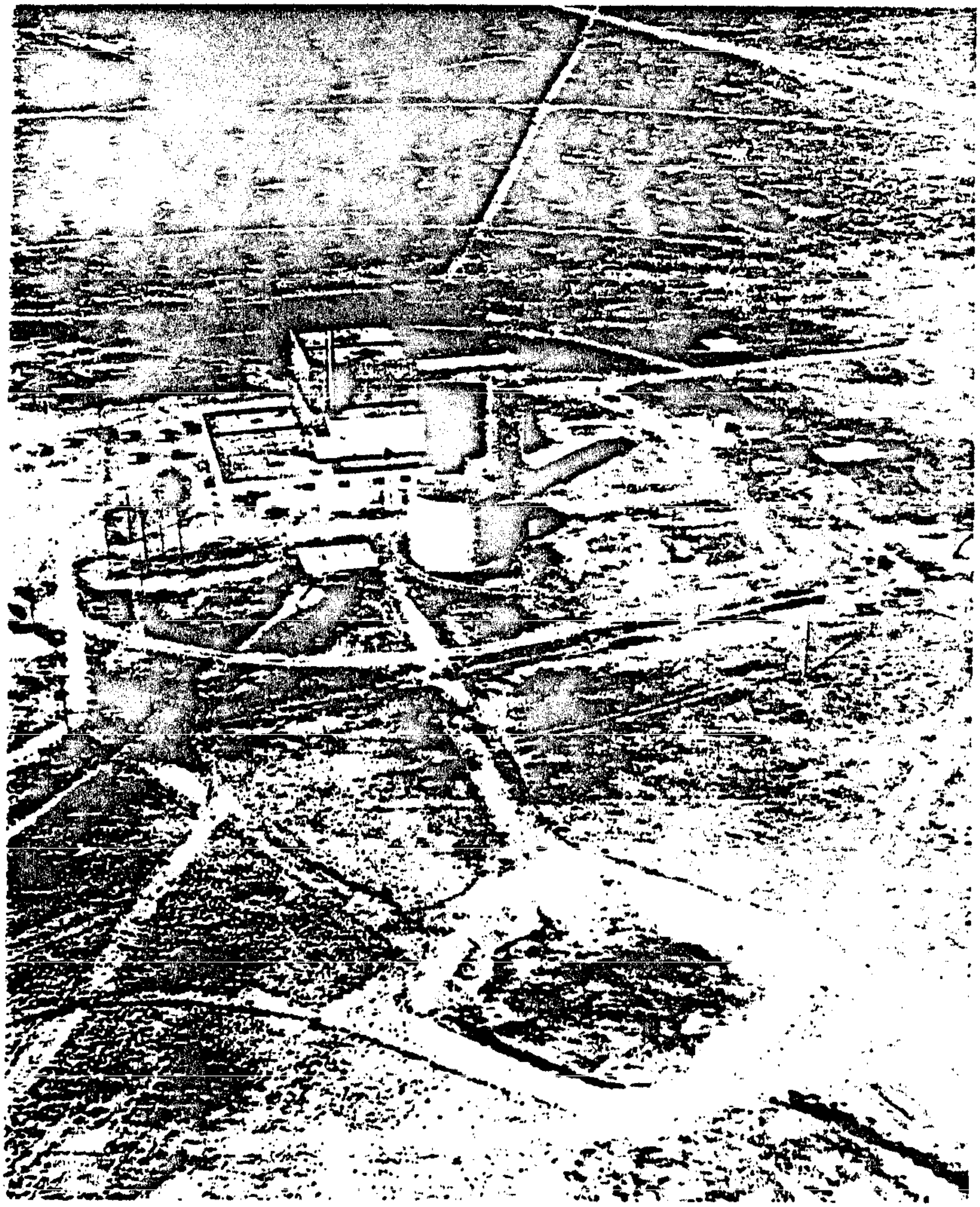


Figure 4.8.4. An aerial view of EOCR, looking toward the southwest.

According to the present Deputy of the National Oceanographic, Atmospheric and Administration (NOAA), that organization used part of the EOCR Building for storage from 1976 to 1984. This inventory included wires, equipment, rubber tires, and air samplers. All these materials were removed prior to occupancy by the current occupant, the Special Response Team.

4.8.2.1.1 Nitrate Resin Reactivity Test--This test was conducted in September of 1983. Its purpose was to determine the explosive characteristics of nitrates in ion-exchange resins. The tests involved the use of 10 gallons of nitric acid and 10 gallons of resins. This test took place approximately 100 yards from the EOCR.

4.8.2.1.2 SWEPP Drum Tests--During the period from July 24 to August 11, 1982, two tests were conducted with simulated sludge and two tests with combustible waste. The purpose of these tests was to provide step-by-step instructions for conducting explosive tests of hydrogen-oxygen-nitrogen mixtures contained within simulated radioactive waste packages. The simulated sludge consisted of diatomaceous earth moistened with water. The combustible waste consisted of miscellaneous dumpster debris. The percentage of hydrogen in the drums ranged from 11 to 30%.

4.8.3 EOCR Disposal Sites

EOCR building 610 is currently used as a storage area for minor amounts of hazardous materials. The materials known to have been stored there as of November 1984 were: two ft^3 of mercury-containing material (i.e. thermometers), 2 lbs of picric acid, 20 grams of Dipicrylamine, magnesium rods and powder, fired zirconium turnings, and resins. As of the date of this report, most of these materials have been removed and no others are scheduled to be stored here.

Table 4.8.1 summarizes the total waste generated at EOCR from the time of construction to present.

TABLE 4.8.1. HAZARDOUS WASTE FROM EOCR

Facility	Waste Stream	Time Frame	Estimated Quantities	Treatment/Storage Disposal
Reactor Building #601	H_2SO_4 NaOH	1960-62	908 L/yr 1363 L/yr	Disposed of in diluted form to leaching pond
Outside EOCR	Nitric Acid Resins	1983	37.8 L/yr 37.8 L/yr	100 yards away from Reactor Building
EOCR-601	Mercury waste	1980-present	0.0464 m^3	Stored in EOCR-610
	Magnesium rods & powder		20 lbs	Stored in EOCR-610

4.9 Organic Moderated Reactor Experiment (OMRE) Past Activity Review

4.9.1 OMRE Facility Description

The Organic Moderated Reactor Experiment (OMRE) was built by Atomics International at the Reactor Testing Station. Construction was completed in May 1957, with fuel loading in September of that same year. It continued in operation until shutdown of the reactor in 1963.

The OMRE facility consisted of the reactor control building, water tank, pump house, leaching pond storage area, and drum tank vault area. Figure 4.9.1 shows specific locations. Within these facilities, three types of circulation were used: The coolant system circulated 9,200 gal/min of coolant from the reactor to an air-blast heat exchanger with a nitrogen blanket; the auxiliary cooling system removed heat from the reactor core during shutdown (a water spray cooler and filtering equipment were part of this system).

The overall objective of the OMRE experiment was to achieve an economical power supply generated by an organic coolant. The experiment provided a basis for the study of three system variables:

1. A study of coolant decomposition rates at various boiler (high boiler) concentrations in the coolant

2. A study of the effect of bulk coolant temperature on coolant decomposition rate

3. A study of heat transfer surface characteristics with increasing fuel plate surface temperature.

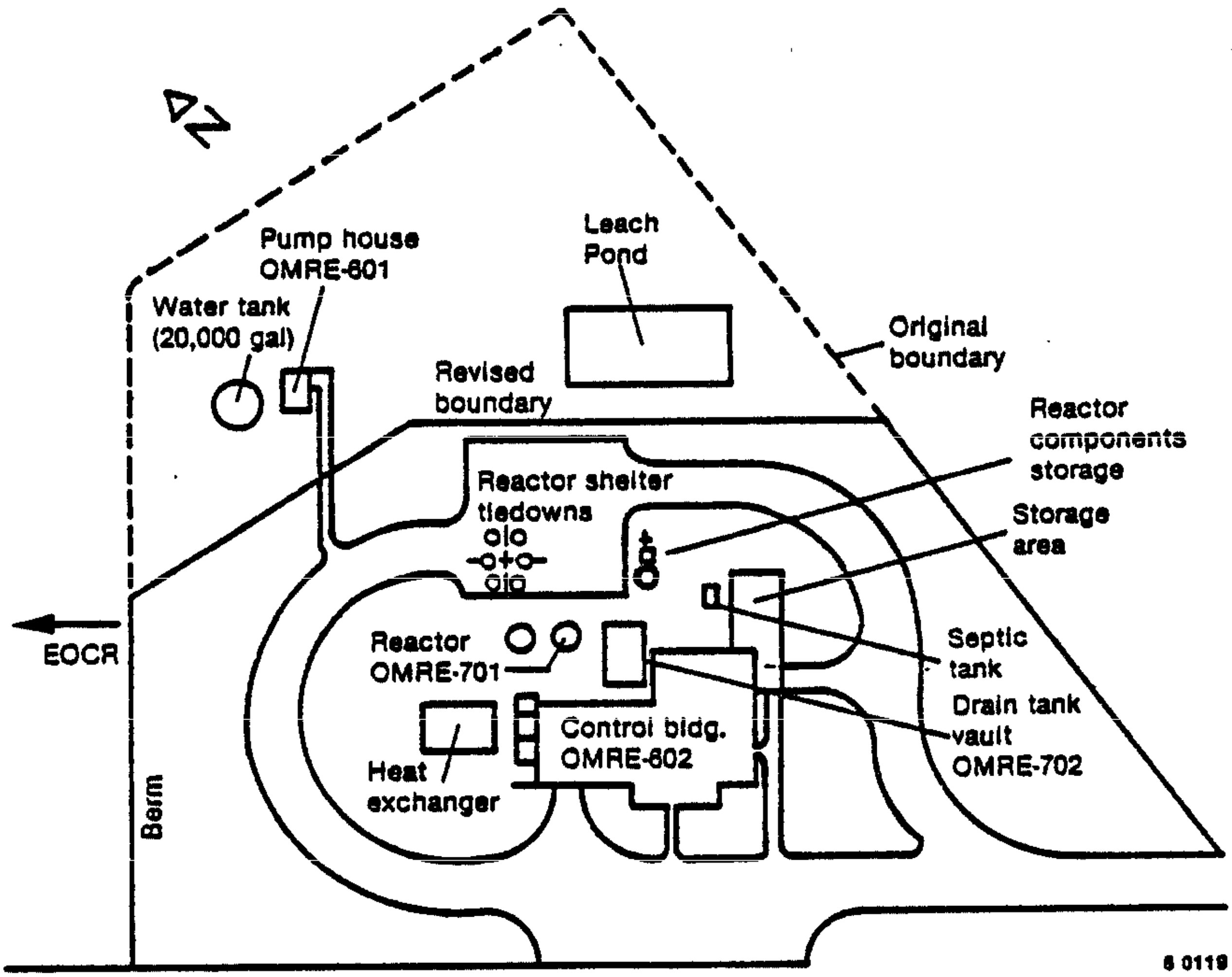


Figure 4.9.1. OMRE site boundaries.

The purification system removed damaged hydrocarbon from the main coolant system and consisted of a distillation unit, adsorption on a bed of Attapulgus clay and a filtration unit, through which impurities were removed from high boiling compounds as waste for storage.

4.9.2 OMRE Wastes Generated by Activity

The organic coolants used were a mixture of organic molecules called polyphenyls, which consisted of diphenyls and terphenyls. The Santowax (OMRE coolant) consisted of a low-melting mixture of diphenyl and three terphenyls.

Polyphenyls, like organic materials in general, tend to decompose when subjected to heat or ionizing radiation. In both instances, most of the decomposition products recombine to form molecules larger than the original polyphenyls. Up to a point, this change in composition improves the coolant properties (lower melting point, lower decomposition rate); hence OMRE reactors were designed to run with Santowax R containing about 30% decomposition products (high boilers).

4.9.2.1 Gaseous Wastes. In the reactor vessel, a continuous purge of nitrogen over the surface of the coolant prevented buildup of hydrogen and light hydrocarbon gases (which are formed during decompositions of the coolant under irradiation) and swept these gases to the exhaust stack.

Table 4.9.1 represents a typical analysis of the gaseous decomposition products formed during reactor operation.

4.9.2.2 Liquids and Solids. Figure 4.9.2 is a schematic flow diagram of OMRE. Note that the waste is generated by the purification system; therefore, this system will be analyzed in more detail.

TABLE 4.9.1. TYPICAL DECOMPOSITION GASES

Compound	Vol %
Hydrogen	62.8
Methane	10.5
Ethane and ethane	18.0
Propane and propane	5.9
Butane and butane	2.1
	99.3%

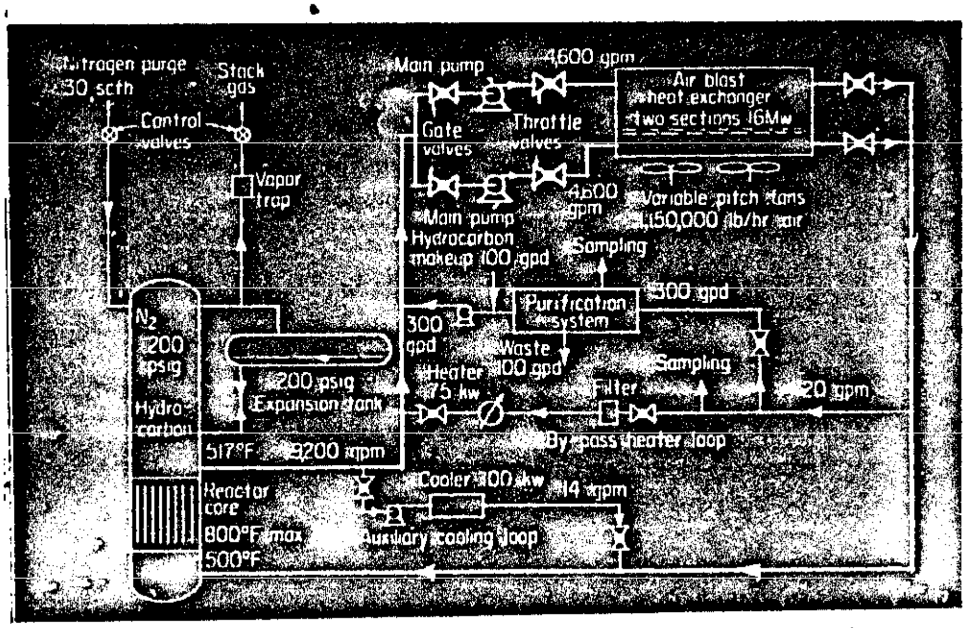


Figure 4.9.2 OMRE flow diagram shows coolant-purification bypass.

The purification system removed a small batch of damaged hydrocarbon from the main coolant stream each day, purified it, and returned the purified material (with additional fresh makeup) to the reactor coolant system. The waste was rejected to storage.

A small number of low boilers (compounds with boiling points in the range of 80-254°C) were isolated and identified. The most important of these were benzene, toluene, ethylbenzene, p-ethyltoluene, m- and p-xylene, n-propylbenzene and indanes. Traces of at least 14 others have been detected. Table 4.9.2 gives a summary of the low-boiler contents of the OMRE coolant.

A minimum of 13 intermediate boilers (compounds with boiling points in the range of 254-383°C) were detected in the OMRE coolant. Four of these compounds have been identified: 3-methyl-biphenyl, flourene, phenanthrene, and 9-fluorenone. The others were of too low concentrations to be of consequence. Table 4.9.3 gives sample contents of the major intermediate boilers in the OMRE coolant from Core II.

The high-boiler fraction of the decomposition product was found to be a very complex chemical system. Clear-cut separation of individual components was extremely difficult. Only 75% of the high-boilers have been identified in the OMRE coolant sample. See Table 4.9.4 for a sample content of high-boilers from OMRE.

Finally, Table 4.9.5 summarizes all four groups of decomposition product in the order of their volatility.

4.9.2.3 Radioactive Waste Generated by OMRE. The radioactivity of the OMRE coolant came mostly from the activation of impurities either originally present in the coolant or from those introduced into the coolant in the form of rust, welding slag, and metal filings from the OMRE piping vessels. A major part of these impurities was in a less volatile form than was the OMRE coolant itself and was therefore removed with the waste from

TABLE 4.9.2. SUMMARY OF LOW-BOILER CONTENT OF OMRE COOLANT

	Concentration (wt %)			
	Core I		Core II	
Low Boilers	Range	Average	Range	Average
Benzene	0.003-0.154	0.089	0.006-0.134	0.056
Toluene	0.004-0.154	0.112	0.006-0.125	0.073
Ethylbenzene	0.005-0.176	0.129	0.007-0.099	0.066
Other low boilers	0.02-0.57	0.41	0.05-0.70	0.32
Total low boilers	0.03-0.98	0.74	0.09-0.95	0.52

TABLE 4.9.3. MAJOR INTERMEDIATE BOILERS IN OMRE CORE II COOLANT SAMPLES

Sample Date	Cumulative Exposure (Mwd)	HB Content (wt %)	Intermediate Boiler (wt %) 3-Methyl-biphenyl	Fluorene	Phenan-threne	Total (wt %)
6-1-59	0	0.9	0.26	0.41	1.69	2.36
6-18-59	27	8.6	0.26	0.46	0.84	1.56
11-12-59	496	29.2	0.27	0.47	0.61	1.35
1-7-60	747	31.1	0.30	0.62	0.57	1.49

TABLE 4.9.4. TYPICAL COMPOSITION OF OMRE HIGH BOILERS

Substituted polyphenyls	Wt %	Substituted triphenylenes	Wt %
Alkylterphenyls	0.5	Triphenylene	9.1
Quaterphenyls	8.6	Alkyltriphenylenes	1.3
Alkylquaterphenyls	1.3	Phenyltriphenylenes	0.8
Quinquephenyls	16.8	Alkylphenyltriphenylenes	1.1
Alkylquinquephenyls	1.5	Diphenyltriphenylenes	1.5
Hexaphenyls	25.8	Alkyldiphenyltriphenylenes	1.4
Alkylhexaphenyls	1.1	Triphenyltriphenylenes	2.5
Heptaphenyls	1.6	Alkyltriphenyltriphenylenes	0.8
Alkylheptaphenyls	0.1	Tetraphenyltriphenylenes	0.1
Octaphenyls	0.8		
Totals	58.1		18.6

TABLE 4.9.5. DECOMPOSITION PRODUCTS OF OMRE COOLANT

Group	Boiling Range (°C)	Approximate Yield (wt %)	Types of Compounds
Gases	-259 to 80	1	Hydrogen, alkanes, alkanes, and alkynes to C_6
Low boilers	80 to 254	1-2	Aromatics and alkylaromatics
Intermediate boilers	254 to 383	5-10	Alkylaromatics and alkylpolyphenyls
High boilers	>383	85-90	Aromatics and alkylaromatics, including polyphenyls and fused ring types

the purification system, which acted as a decontaminating unit. The most important of the activities observed were Mn^{54}, Mn^{56}, Fe^{59}, Co^{60}, Se^{75}, S^{35}, and P^{32}. During normal operation, the specific activity of the coolant was approximately 0.1μC/cm^3 at a power level of 6.0 MW.

Cleanup of the OMRE coolant and coolant system proceeded in parallel with removal of the first core. The coolant was distilled in the purification system for reuse with the second core loading. The vessel and piping were flushed with a solvent (xylene) to loosen any particulate matter from the walls and carry this particulate matter to a temporarily installed filtering system.

4.9.3 <u>OMRE Shutdown</u>

The reactor was shut down on April 3, 1963 at the completion of CORE III operations. Deactivation steps were begun shortly thereafter under OMRE Maintenance and Operational Development. By the end of fiscal year 1963, all 32 fuel elements had been removed from the reactor vessel.

4.9.3.1 <u>Organic Coolant</u>. The organic coolant drained from the system was drummed out and stored on site, along with the coolant and high boilers loaded out previously . These contaminated items were shifted to the NRTS burial ground. During that period, 43 drums of Core III-HB were shipped to AECL in Canada, and 50 lb were shipped to the Juenta de Energia Nuclear in Spain. These drums were identified by drum number, color-coded, and grouped by content. A total 696 drums were removed from the site after shutdown.

Following the shipment of the last two fuel elements, the fuel-washing system was deactivated, drained, and secured. All contaminated fluids and surface area decontamination were discarded. The water system and storage tank were drained and all water pumps shutdown. Propane, nitrogen, carbon dioxide, xylene, gasoline, and other industrial liquids and gases were removed from the site.

4.9.3.1 OMRE Leaching Pond Characterization. OMRE was decommissioned during FY-78 and 79. As part of the D&D plan, it was necessary to characterize the OMRE leaching pond.

The OMRE pond is approximately 8 m wide by 22 m long with a slope to the pond base. The base of the pond is approximately 5 m wide by 15 m long. The depth of the soil to basalt in the base varies from 30 cm at the east end to 46 cm at the west end.

The amount of effluent discharged to the pond during the operation of the reactor is listed in Table 4.9.6. The organic effluent which is mentioned in Table 4.9.6, is definitely xylene, with possible dissolved low-boilers and intermediate-boilers from the reactor residue after purification. This table specifies the radioactivity of the pond, along with identified nuclides. There are no records for the initial operation period between 1957 and 1959.

4.9.4 OMRE Spills and Accidents

On December 20, 1960, a fire occurred at the organic coolant makeup tanks located on the north side of the maintenance shop section of the OMRE control building.

There were two tanks, one with a capacity of 500 gallons, the other 1500 gallons. The design pressure of the tanks was listed as 400 psi. Both tanks were heated to a temperature of between 300 and 350°F in order to keep the organic coolant in a liquid state. Normal heating was accomplished by induction heating of coils in the tank shell and related piping. Supplementary heat was occasionally provided by resistance heaters on the bottoms of the tanks.

Due to extensive damage to the wiring and related tank equipment, it was difficult to establish the exact cause or source of ignition. However, it is believed that a short circuit in the induction heating wire was the

TABLE 4.9.6. OMRE LEACH POND RADIOACTIVE INVENTORY

	1959 [a]	1960 [b]	1961 [c]	1962 [d]	1963	TOTAL
Activity [(e)] (mCi)	120.8	79.9	2.52	--	2,150	2,353.22
Volume (liters)	4,012	41,618	23,334	--	52,990	496,518

a. Two radioactive liquid discharges were recorded as being discharged to a "ditch" outside OMRE. These two discharges totalled 0.4 mCi and 2.687 liters. An additional discharge consisting of 0.9 mCi and 22,710 liters was reported as being released to a trench. The "trench" may or may not have been the previously mentioned ditch. The contaminants for the latter discharge were noted as: ^{32}P, ^{35}Sb (?), ^{54}Mn, ^{58}Co, ^{59}Fe, ^{60}Co, ^{131}I, ^{140}Ba, ^{140}La, and xylene particulates. These three releases are not included in the 1959 values of this table.

b. Included in these values are three releases noted as "organic." The activity of these releases was 5.5 mCi, the volume was 1,344 liters.

c. Records reported 5.68×10^5 liters of nonradioactive cooling water was released to the leaching pond in addition to the contaminated water.

d. No releases recorded.

e. The nuclides reported were: ^{54}Mn, ^{59}Fe, ^{95}Zr, ^{95}Nb, ^{103}Ru, $^{141-144}Ce$, ^{129}I, ^{90}Sr, ^{90}Sm, ^{131}I, ^{106}Rh, ^{89}Sr, ^{137}Cs, and unidentified beta-gamma (normally notes as <10%).

probable cause. There were other factors that would have contributed to the seriousness of this accident had there been an extended delay in controlling the fire or had wind conditions been different.

Equipment damaged by the fire included: Tank instruments and tubing, wiring, thermocouples, insulation, tank coolant circulation pump and motor, and weatherproofing. Water damage was negligible.

No direct radiation or radioactive contamination was involved, and there were no injuries to personnel.

4.9.5 Decontamination and Decommissioning of OMRE

The OMRE Facility was decontaminated and decommissioned in 1980 and was returned to DOE for further use. That project involved the removal and disposal of all contaminated articles, including plant hardware, soil, and some basaltic rock, and salvaging all uncontaminated items. All material was surveyed to segregate the contaminated from the noncontaminated. The noncontaminated, nonhazardous material that was not salvageable was sold as scrap.

All contaminated material (>0.1mR/hr) was shipped to the Radioactive Waste Management Complex (RWMC) for disposal. Table 4.9.7 is a summary of the major types of waste resulting from that project. It is important to note that the volumes listed in the contaminated-waste column are not the volumes of these wastes alone; they are the volumes required in the burial ground by these materials and their containers.

4.9.5.1 Soil Spill Incident (D&D). In October 1978, a shipment of radioactive soil en*** route from OMRE to the RWMC sprang a leak and spilled an estimated 0.5 ft^3 of soil. A 2 x 4 x 8-ft plywood box (about 5,500 lbs) was transported with support under the ends only and the weight of the soil opened a bottom seam of the box. Radiation was measured at

TABLE 4.9.7. OMRE WASTE SUMMARY

Waste Type	Clean		Contaminated
Metallic	860 ft^3		40,000 ft^3
Concrete	110 ft^3		600 ft^3
Soil	--		9,500 ft^3
		Total	51,000 ft^3

5,000 cpm for the soil that was collected from the truck bed. As a result of this incident, the box design was strengthened and specific instructions regarding shipping and tie-down were emphasized.

4.9.6 Environmental Monitoring at OMRE

Environmental monitoring activities at OMRE were begun in 1980 by the EG&G Idaho Environmental Surveillance Program, conducted by the Waste Technology Programs Branch. These monitoring activities involve semiannual surface radiation surveys and the collection of limited numbers of soil samples for radioanalysis.

Eight routine surface-soil samples were collected in the spring and fall of 1984 from the locations shown in Figure 4.9.3. Positive detections from the gamma spectrometry analysis are shown in Table 4.9.8. Six positive detections were obtained for Cs-137, one positive for Co-60, and one positive for Eu-152. Both Co-60 and Eu-152 are activation products and are probably residual activity remaining from decontamination and decommissioning of OMRE.

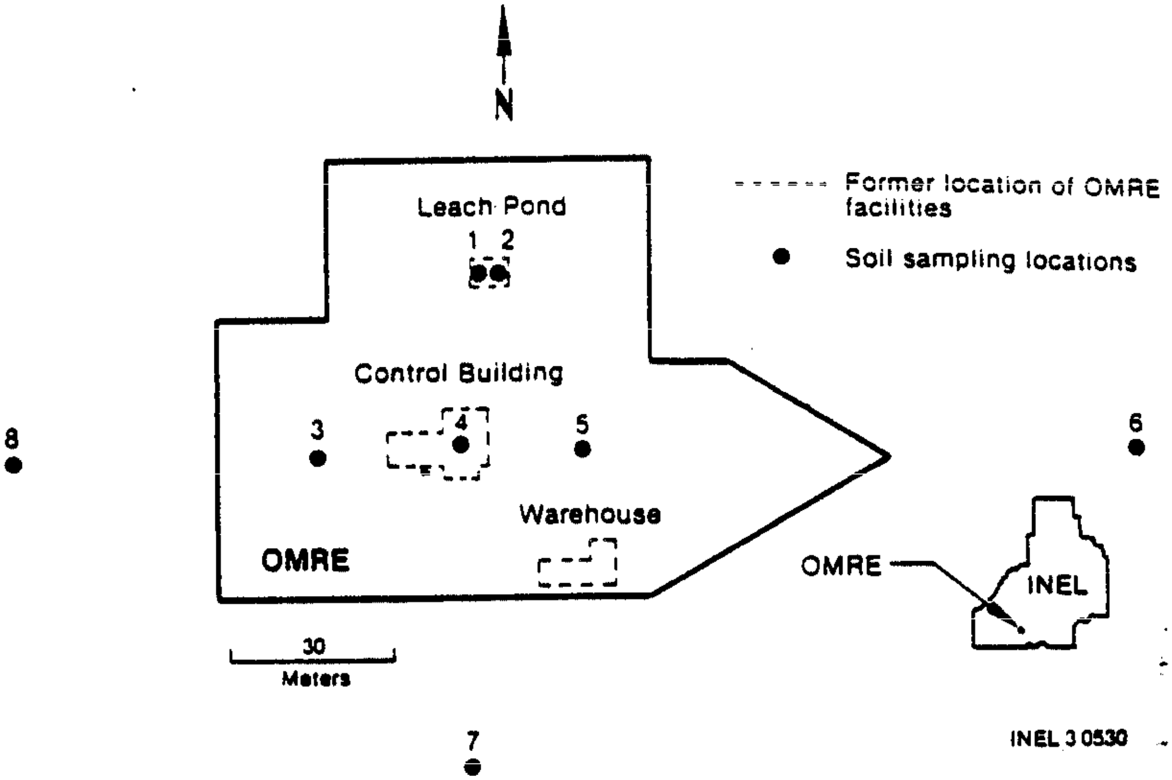


Figure 4.9.3. OMRE soil sampling locations.

TABLE 4.9.8. RESULTS OF GAMMA SPECTROMETRY ANALYSIS OF ROUTINE OMRE SOIL SAMPLES[a]

Time of Collection	Sampling Location	Radionuclide	Concentration (10^{-6} μCi/g)[a]	Percentage of D&D Interim Screening Level[b]
Spring	4	Co-60	0.23 ± 0.08	23
		Eu-152	0.53 ± 0.15	18
	5	Cs-137	0.16 ± 0.05	3
	6[c]	Cs-137	0.86 ± 0.13	14
	7[c]	Cs-137	1.00 ± 0.14	17
	8[c]	Cs-137	0.96 ± 0.07	16
Fall	7[c]	Cs-137	1.11 ± 0.20	19
	8[c]	Cs-137	0.44 ± 0.10	7

a. Analytical uncertainties presented are ± 1σ.

b. INEL D&D interim screening levels are based on concentrations of radionuclides that produce a projected dose of 10 mrem/yr above background to a full-time occupant.

c. Control.

4.10 BORAX Past Activity Review

4.10.1 BORAX Area Description

The BORAX Program, initiated by Argonne National Laboratory in 1953, was conducted primarily to increase our knowledge of the basic reactor physics of boiling water reactors and to investigate the interaction among components of various systems of the reactor/power-generation train. This program involved multiple tests on five separate reactors. Modifications were made to each reactor between tests.

BORAX-I was the first experiment in a series consisting of BORAX-I, -II, -III, -IV, and -V. The experiments were conducted during the summers of 1953 and 1954. In July 1954, the BORAX-I reactor was intentionally destroyed during a power excursion and after cleanup was buried in place. A new site, northeast of BORAX-I, was selected for BORAX-II through -V experiments. Figure 4.10.1 shows this new site, which is the existing but no longer active, BORAX-V Facility.

4.10.1.1 Waste System Description. There is no descriptive data available on the waste generated while BORAX-I was active. However, RWMC records confirm that radioactive waste was disposed of from 1953 to 1968 by Argonne National Laboratory Building No. 601, which includes BORAX-I-V, EBR-I and ZPR-I.

The waste disposal systems at BORAX-I and BORAX-II were based on criteria related to personnel safety, i.e., advantage was taken of the remote location relative to disposal of gaseous and liquid radioactive waste. The waste disposal requirements were concerned mainly with long-lived decay radioactivity. Since the duration of individual runs was kept relatively short, the resulting fission-product build-up inventory was kept at manageable levels, and disposal requirements were satisfied by dilution in water and atmospheric dispersion.

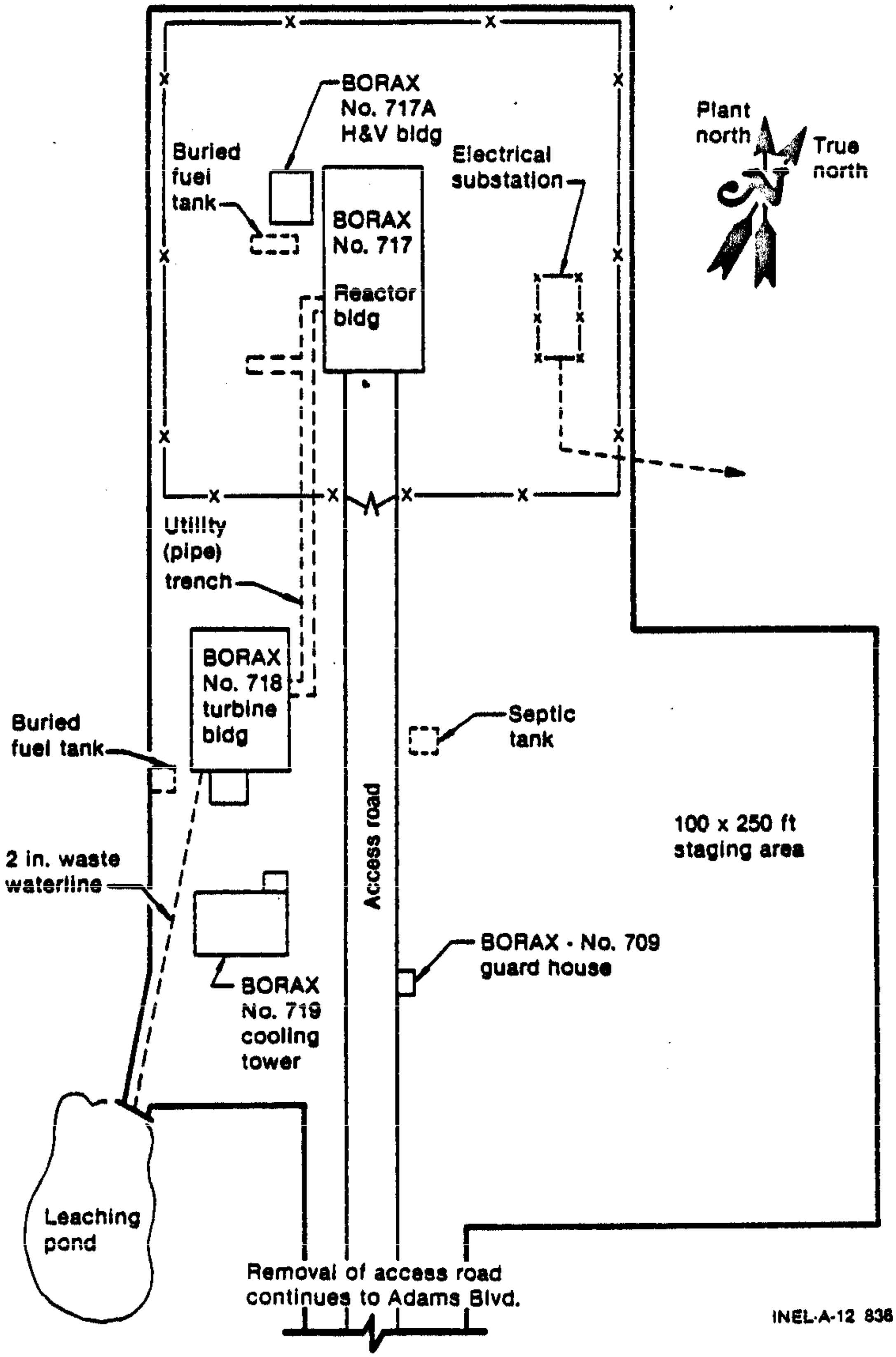


Figure 4.10.1. BORAX-V site boundary.

4.10.2 BORAX Waste Generated by Activity

4.10.2.1 BORAX-I: Radiological Characterization. EG&G's radiological characterization of the BORAX-I reactor area was performed as a prelude to the decontamination and decommissioning (D&D) of the area. The present BORAX-I site is shown in Figure 4.10.2; it consists of a radiologically contaminated area and the buried remains of a reactor.

Some equipment from the reactor was successfully decontaminated and salvaged for use in BORAX-II which was being constructed at what is now the BORAX-V site.

The BORAX-I contaminated area is approximately 150,016 ft^3 in volume. Included in that area are 166 ft^3 of metal waste (reactor vessel, shield tank, piping, etc.) and 770 ft^3 of concrete. Assuming a soil density of 1 ton/yd^3, 1.10×10^7 pounds of soil were calculated to be present. Assuming a packaged density of about 2 ton/yd^3 for the metallic waste, 2.46×10^4 pounds of metal were calculated to be present. Table 4.10.1 gives the D&D results of a miscellaneous soil-sample analysis from the BORAX-I contaminated area; a total of 37 curies of Cs-137 and 0.726 curies of U-235 were calculated for the area, as shown in Table 4.10.2.

4.10.2.2 BORAX-III: Waste-Generating Activity (Radioactive). BORAX-III was the first of the BORAX experiments to use steam for the production of electrical power and so was the first to be connected with water quality.

The fuel in BORAX-III was uranium-aluminum alloy clad with 2S aluminum. The use of aluminum meant that the pH should be kept on the acid side of neutrality to minimize corrosion. The problems connected with the reactor water were an important part of the BORAX-III program, the first step being to maintain water purity as high as consistent with the

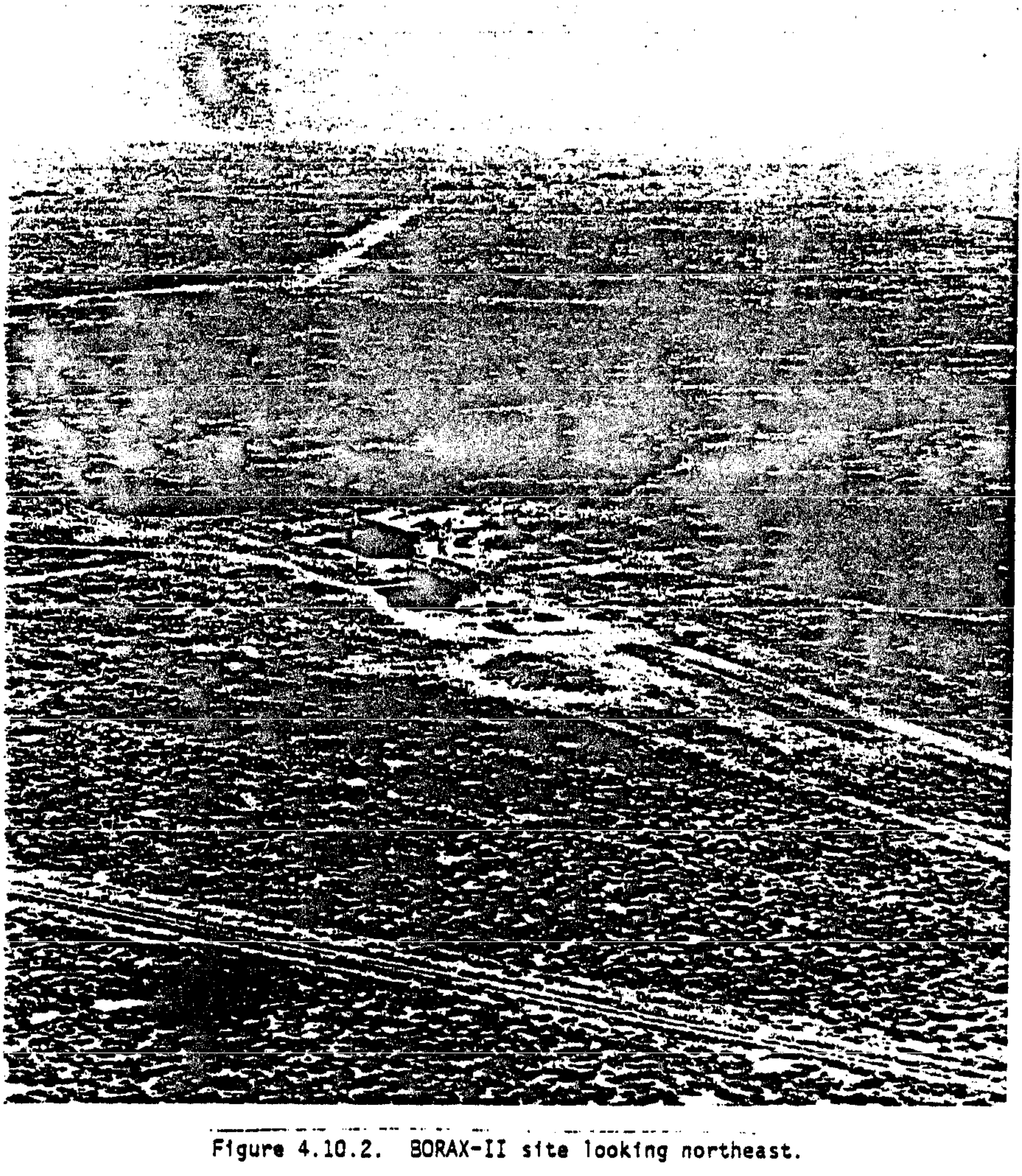


Figure 4.10.2. BORAX-II site looking northeast.

TABLE 4.10.1. RESULTS OF MISCELLANEOUS SAMPLES ANALYSIS OF BORAX-I[a]

Sample No.	Description	Wt (g)	^{235}U (pCi/g)	^{137}Cs (pCi/g)	Ratio ^{137}Cs to ^{235}U
1	Surface soil	623	144 $\pm$ 3	7334 $\pm$ 15	51
2	Surface soil	623	7 $\pm$ 1	214 $\pm$ 3	31
3	Soil at 15 cm deep	597	28 $\pm$ 1	1241 $\pm$ 5	44
4	Soil at 30 cm deep	458	3.6 $\pm$ 0.5	108 $\pm$ 3	30
4	Sample 4 rotated 90°	458	4.0 $\pm$ 0.5	137 $\pm$ 3	34
4	Sample 4 rotated 180°	458	5.6 $\pm$ 0.6	177 $\pm$ 4	32
4	Sample 4 rotated 270°	458	4.0 $\pm$ 0.5	144 $\pm$ 3	36
5	Metal fragment	80	3306 $\pm$ 19	17,740 $\pm$ 59	5.2
6	Seven tiny metal fragments	70	2261 $\pm$ 20	86,370 $\pm$ 138	38
7	Surface soil and gravel	88	121 $\pm$ 3	6056 $\pm$ 22	50

a. These samples contain activity concentrations which are orders of magnitude above INEL background. The INEL background concentrations for ^{235}U and ^{137}Cs are 0.05 pCi/g and 1 pCi/g, respectively. Because of the long half-life of ^{235}U (7×10^8 years), the decay time required to reduce the above samples to INEL background is, for all practical purposes, endless.

TABLE 4.10.2. TOTAL NUCLIDES CALCULATED FOR BORAX-I CONTAMINATED AREA

Nuclides	Conc. of Nuclides Used (pCi/g)	Total Curies
U-235	144-soil 3306-metal	0.756
Cs-137	7334-soil 86,376-metal	37.6
Sr-90	2.7-soil	0.0135
Beta/Alpha	30-soil	0.150

desired pH. Figure 4.10.3 shows this cleanup circuit, which consisted of filters and ion-exchange columns. In operation, these became quite radioactive; consequently, they were installed in the cement fuel-storage pit so that the water provided the necessary shielding.

During normal operation, steam flowed in a closed-cycle mode. However, pressure relief and excess steam were released directly to the atmosphere. The carryover of activity from the reactor water into the steam phase did not reach high levels. Decontamination factors (the ratio of the original level of radioactivity to the level that remains after decontamination) were in the range of 0.6 to 1.6 x 10^4. Indications from short-term operation were that short-lived activities did not accumulate in the external circuit. For example, the activity at the exhaust end of the turbine, twelve hours after final shutdown, read 1 to 1 1/2 mR/hr through the turbine casing.

4.10.2.2.1 Description of Disposal Methods for BORAX-III--The following methods of disposal of wastes were used:

- Liquid: Radioactive liquid wastes were directed through an approximately 2-in. diameter pipe to a leaching pond remotely located on the desert floor. The reactor water activity of 340 µCi/mL of water was due primarily to Na-24. Nonradioactive liquid industrial wastes, comprising primarily cooling tower blowdown, were directed through 1-1/2-in. diameter steel pipe to the same leaching pond.

- Solids: Solid radioactive wastes were collected and disposed of in the NRTS burial ground (now known as RWMC).

- Gaseous: Gaseous discharge, where occurring, was directed to the atmosphere. Some gas removed from the condenser by the steam ejector had activity of approximately 1.4 µCi/mL of gas of N-16 and A-41.

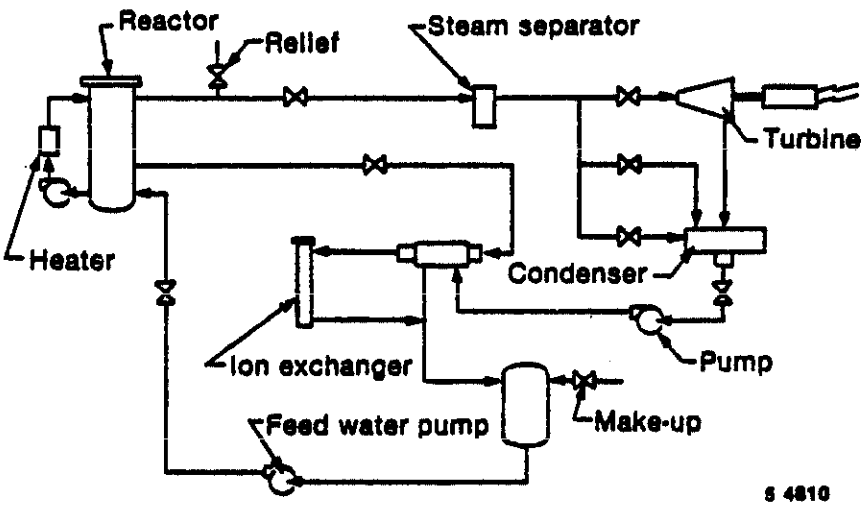


Figure 4.10.3. BORAX-III flow diagram.

4.10.2.2.2 <u>Specific Nuclides Identified for BORAX-III</u>--Measurements*** of entrainment were made on the BORAX-III reactor. Activities carried by steam and the condensate were sampled and compared to the activities in the reactor water.

Activation products dissolved in the water were derived from natural impurities, from corrosion products of the reactor and steam system, and from dissolved gases present in the water. Activity in the steam and condensate came from reactor water droplets carried as entrainment and from volatile activation products.

Table 4.10.3 is a list of radionuclides observed in the reactor water. The presence of Ba^{140}, Ce^{141}, and Ce^{144} which are daughters of the volatile fission products of Xe^{140} and Xe^{141} respectively, are examples of how long-lived activities could contribute to the differing decay rates of the overhead steam of the reactor water. The presence of fission products in the reactor water appeared to be the result of very slow leakage through the fuel element cladding.

4.10.2.3 <u>Waste Generated by BORAX-IV (Radioactive)</u>. From the standpoint of water chemistry, BORAX-IV was not significantly different from BORAX-III. The combination of mixed-bed and cation exchangers operated with parallel flow, found best in BORAX-III, was continued in BORAX-IV. Instead of operating at low pressure, however, as in BORAX-III, the purification system in BORAX-IV was designed for reactor system pressure (see Figure 4.10.4). Fuel cladding in BORAX-IV was the aluminum alloy 7388 instead of 2S as used in BORAX-III. A pH range of 5 to 6 was maintained in the water in order to reduce corrosion.

Argonne National Laboratory conducted a test in BORAX-IV in 1958. The purpose for that experiment was to determine the limiting factors on the operation of this reactor with a fuel defect. Measurements which were made during reactor operation included the following:

- Radioactivity levels of the steam plant equipment

TABLE 4.10.3. RADIOACTIVE CARRY-OVER FROM BORAX-III: RADIOACTIVITIES OBSERVED IN REACTOR WATER AND FILTER

Element	Probable formation	Half-life
N^{16}	$N^{15}(n, \gamma)$, O^{16} (n, p)	7.3 sec
Cl^{38}	Cl^{37} (n, γ)	37.3 min
A^{41}	A^{40} (n, γ)	110 min
Mn^{56}	Mn^{55} (n, γ)	2.6 hr
Cu^{64}	Cu^{63} (n, γ)	12.8 hr
Na^{24}	Na^{23} (n, γ); Al^{27} (n, α)	15.0 hr
Cr^{51}	Cr^{50} (n, γ)	27 days
Fe^{59}	Fe^{58} (n, γ)	46 days
Sr^{89}	Sr^{88} (n, γ)	54 days
Ca^{45}	Ca^{44} (n, γ)	152 days
Zn^{65}	Zn^{64} (n, γ)	250 days
	Fission activities observed in reactor water	
Mo^{99}		67 hr
Ba^{140}:	Xe^{140} 16 sec Cs^{140} 66 sec Ba^{140}	12.8 days
Ce^{141}:	Xe^{141} 3 sec Cs^{141} S Ba^{141} 18 min La^{141} 3.7 h Ce^{141}	32 days
Ru^{103}		41 days
Zr^{95}		65 days
Ce^{144}:	Xe^{141} S Cs^{144} S Ba^{144} S La^{144} S Ce^{144}	280 days
Ru^{106}		1 year
U^{238}		

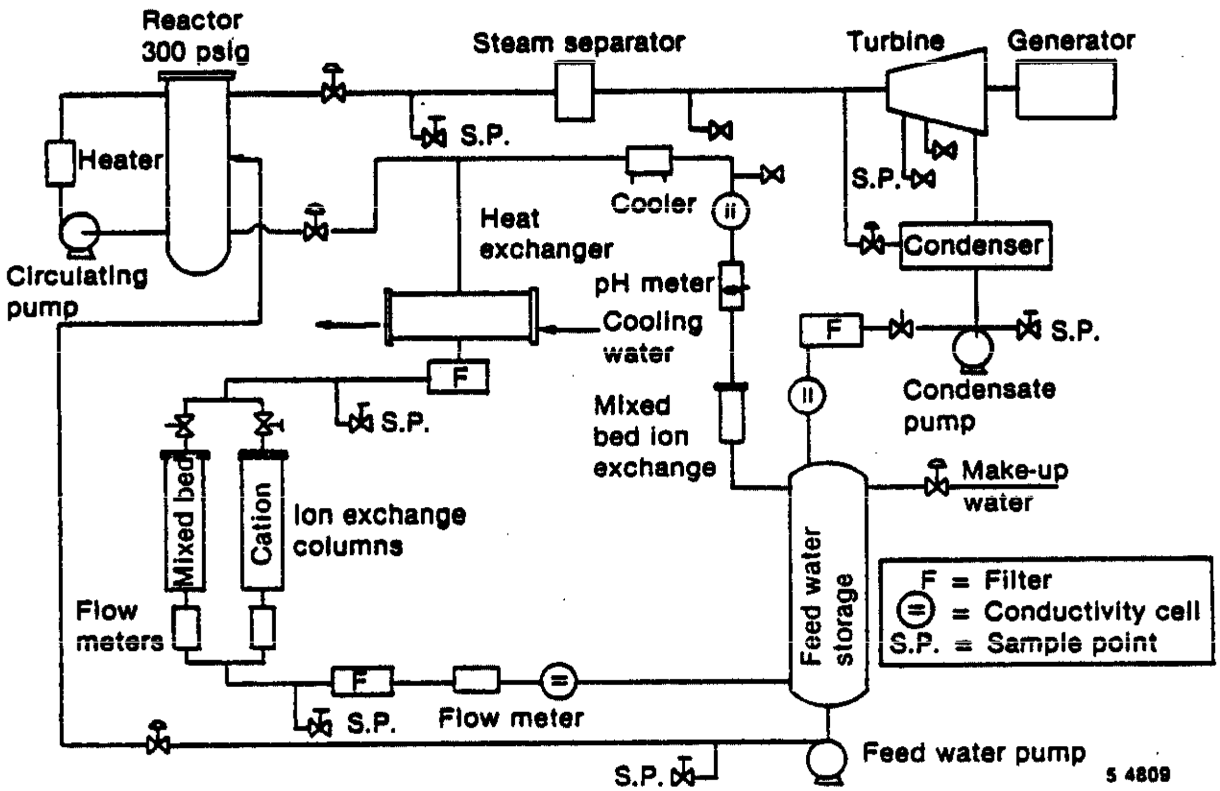


Figure 4.10.4. BORAX-IV flow diagram

- Quantitative determination of the fission gases, Xe^{138} and Kr^{88}, which were released through air ejector

- Analyses of reactor water, condensed steam before the turbine, and condensed steam after the turbine (hotwell condensate) for fission products

- Area contamination downwind of the reactor.

4.10.2.3.1 Radioactivities in Reactor Steam, Hotwell, and Reactor Water--Samples of reactor steam, reactor water, and hotwell condensate were taken during each period of operation at 2.4 MW. Results of analyses are shown in Table 4.10.4. The nuclides which are listed in Table 4.10.4 and Co-58 contribute well over 90% of the observed gamma activity and the majority of the beta activity in the reactor water.

After one year of operation, the total curies discharged from BORAX-IV and contributed by the long-lived nuclides CS-137 and Sr-90, are 0.01 curies and 0.0041 curies respectively. These numbers were converted from Table 4.10.4, with a total of 5,000 gallons of liquid radioactive waste production.

4.10.2.3.2 Waste-Disposal Methods--With the exception of a new fuel design element, the BORAX-IV system comprised the same components and instrumentation used in BORAX-III. Therefore, the waste-disposal methods were essentially the same.

4.10.2.4 Radioactive Waste Generated by BORAX-V. The primary objective of the BORAX-V program was to test nuclear superheating concepts and to advance the art of boiling water reactor design by performing experiments which improved the understanding of factors limiting the stability of boiling water reactors at high-power densities.

TABLE 4.10.4. RADIOACTIVITIES IN BORAX REACTOR WATER, STEAM, AND CONDENSATE

Date	Time	Location	Cs^{138}	Cs^{137}	Ba^{140}	Sr^{89}	Sr^{90}	I^{131}	Mo^{99}
3-11-58	1107	Reactor water	--	--	--	--	--	710	--
3-11-58	1410	Reactor water	2.2×10^6	1.1×10^4	4.3×10^3	1.1×10^4	420	4.0×10^3	--
3-11-58	1580	Steam	--	19	120	1.2×10^3	neg	120	--
3-11-58	1415	Condensate	2.2×10^6	16	60	570	neg	130	
3-12-58	1330	Reactor water	1.3×10^6	1.2×10^4	7.5×10^3	1.7×10^4	484	3.1×10^3	1.6×10^4
3-12-58	1323	Steam	1.2×10^7	20	120	690	neg	90	neg
3-12-58	1325	Condensate	1.6×10^6	24	47	590	neg	70	neg

N. B (1) "Neg" means <10 d/min/mL.

(2) Uncertainty in above results is about ±30%.

All activities expressed as disintegrations per min per mL of water or condensed steam.
All activities corrected to sampling time

The BORAX-V facility is comprised of the reactor and turbine building, cooling tower, heating and ventilating (H&V) building, and miscellaneous outdoor components. Figure 4.10.1 showed the facility layout and corresponding building numbers. The reactor building houses the BORAX-V reactor vessel, the BORAX-II, -III, and -IV reactor vessels, and the associated reactor support systems. A process flow diagram is shown in Figure 4.10.5.

4.10.2.4.1 Waste Disposal at BORAX-V--The major improvement in the waste-disposal systems involved the filtration and ion exchange of the water system, which was directly related to the level of radioactivity in liquid effluent and the gas-ejection system.

- Liquid: Liquid radioactive discharges were normally at an extremely low level, particularly after the short-lived activation gases N_2 and O_2 decayed. All systems were equipped with drains which discharged into one of the three local sump pits. Pumps delivered the sumpage to a 2-in. steel pipe which discharged to a ditch sloping away from the facility. The drains were intermittent batch quantities in the range of several gallons per minute.

Nonradioactive liquid industrial waste effluent was disposed of in a manner identical to that of BORAX-III and BORAX-IV.

- Solids: Solid radioactive waste comprised filtered cartridges, expended water-purification-system resin and miscellaneous paper and rags that had been in contact with radioactive materials and were collected and packaged for disposal at the RWMC.

- Gaseous: The ventilation system was designed to provide pressure gradient which would ensure leakage from low radioactive areas to the higher radioactive area. Radioactivity was confined below floor level in the reactor building and exhausted through AEC-type filters up a stack.

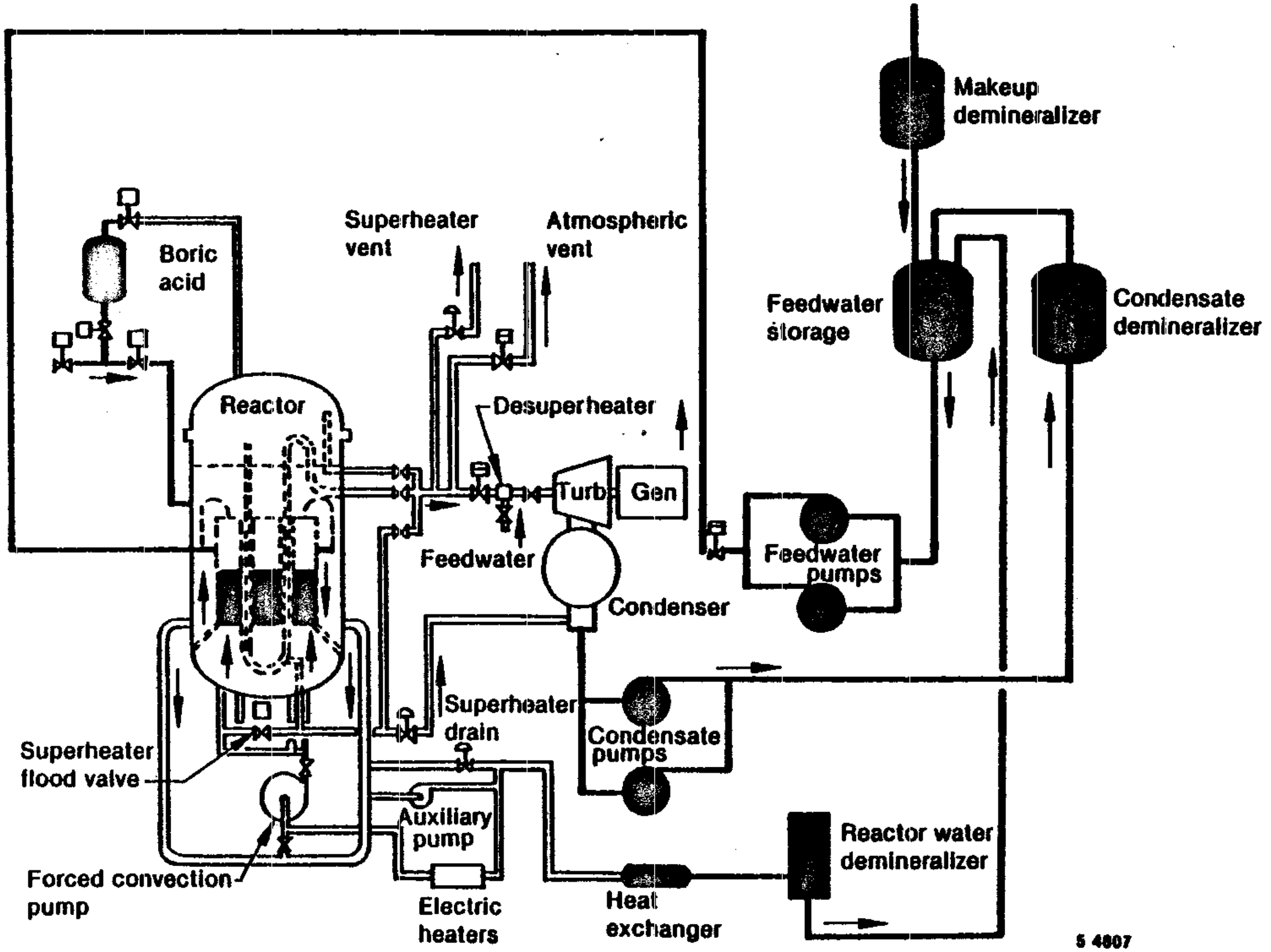


Figure 4.10.5. Flow diagram for BORAX-V.

At the turbine building, noncondensible gases were removed by the air ejector exhaust blower and discharged through a HEPA filter system to the atmosphere. For condensible gases, two filter units, with replaceable elements, were used. The first unit contained a HEPA filter for removal of particulates from the gas; the second contained an activated-charcoal filter for removal of radioactive iodine fission products.

- <u>Nonradioactive Wastes</u>: Nonradioactive solid wastes were collected and sorted. Combustibles were burned at the INEL Central Facilities incinerator, and noncombustibles were sorted for future disposition.

A sanitary-waste disposal system was added to the BORAX-V facility. The sanitary-waste system was isolated from the industrial waste and the radioactive waste systems. There were no interconnections among these three systems. Materials selected for the liquid-effluent systems were based on longevity criteria. Conduit materials for the sanitary system were cast-iron and vitreous clay for permanent underground installation. Industrial waste system materials were selected as a function of the corrosive properties of the liquid effluent and generally consisted of carbon steel.

The sanitary waste effluent was collected from a commode, a shower, and wash basin and was disposed of in a cast-iron header to a septic tank and drainage tile field.

4.10.2.4.2 <u>Present Radiological Description of BORAX-V</u>--The BORAX-V facility was radiologically characterized during May 1979 by the EG&G Waste Management Programs Division. This characterization included level measurements and surface-contamination checks at various locations and in several facility systems. The measurements made at various facility locations are summarized in Table 4.10.5.

TABLE 4.10.5. RADIATION LEVELS IN BORAX-V FACILITY

Building	General Location	Measurement Location	Maximum Reading (mR/hr)
Reactor	Access shaft	All levels	0.1
Reactor	Subreactor room	Floor and walls	0.1
Reactor	Equipment pit-upper level	Walls	0.1
Reactor	Equipment pit-lower level	At sump grating	6
Reactor	Main level	Floor surface above BORAX-II, -III, and -IV reactor vessel	6
Turbine	Both levels	Building in general	0.1
Reactor	Steam-pipe trench	Trench in general	0.1

In addition to the survey of the reactor and turbine building in general, several systems within these buildings were also surveyed. Debris and smears were radiologically analyzed by the Radiological and Environmental Sciences Laboratory/Idaho (RESL/ID) for isotopic content. Results of this system survey are summarized in Table 4.10.6.

Only two isotopes from Table 4.10.6. Only two isotopes Co-60 and Cs-137, were identified. These were measured in the reactor vessel.

4.10.2.5 Radiological Characterization of the Leaching Pond. The BORAX-V Leaching Pond is located approximately 60 ft south of the cooling tower (see Figure 4.10.1). The pond basin is approximately 20 ft x 90 ft and is one foot below grade on the west side and three feet below grade on the other three sides. The earth dike that surrounds the pond is level with the surrounding land, except along the southeastern portion where it slopes down about three feet. A sketch of the pond basin, the surrounding dike, and some elevation are shown in Figure 4.10.6. There are presently two underground carbon steel waste lines that release to the pond, as indicated in Figure 4.10.7. Figure 4.10.8 outlines the path of the wastewater line from the facility to the leach pond.

After establishing a grid system with respect to the Idaho Coordinate System, Eastern Zone, three trenches were dug. Two trenches were approximately 1 1/2 ft x 1 1/2 ft x 2 1/2 ft deep and a third trench was approximately 8 1/2 ft deep.

Soil samples from these three trenches were taken, along with smears and rust samples taken from the inside of the two pipe outlets at the pond. All samples and smears were then sent to the Test Reactor Area--Radiation Measurement Laboratory (TRA-RML) for identification and concentration of the gamma-emitting radioisotopes. The results of that analysis are in Tables 4.10.7 and 4.10.8.

TABLE 4.10.6. RADIOLOGICAL SURVEY OF BORAX-V SYSTEMS

System	System Location	Measured Radiation (mR/h)	Isotope Identified in Debris or Smear
Auxiliary water	Reactor building, subreactor room, bottom level	0.3	None
Feedwater pumps	Reactor building, equipment pit, bottom level	<0.1	None
Equipment pit sump pump	Reactor building, equipment pit, bottom level	1.0	None
Fuel storage demineralizer	Reactor building, equipment pit, bottom level	6.0	None
Forced convection	Reactor building, subreactor pit, bottom level	<0.1	None
Condensate	Turbine building, lower level	<0.1	None
Test loop	Turbine building, lower level	<0.1	None
Steam separator	Turbine building, lower level	<0.1	None
BORAX-II, III, and -IV reactor storage pit (north)	Reactor building, north of BORAX-II, -III, and -IV reactor vessel	80	None
	South of Reactor building	11,000	Cs-137 Co-60
BORAX-II, III, and -IV reactor storage pit (west)	Reactor building, west of of BORAX-II, -III, and -IV reactor vessel	500	None
Water storage pit	Reactor building,	13	Co-60

TABLE 4.10.6. (continued)

System	System Location	Measured Radiation (mR/h)	Isotope Identified in Debris or Smear
Demin. water storage tank	Reactor building, upper level	<0.1	None
Condenser	Turbine building, lower level	<0.1	None
Gland seal tank	Turbine building, over-head	<0.1	None
Boron tank	Turbine building, ground level	<0.1	None
Steam separator	Turbine building, lower level	<0.1	None
Air ejector exhaust	Turbine building, lower level	<0.1	None
Steam valves	Turbine building, upper level	<0.1	None
Pink tank	Turbine building, lower level	<0.1	None
Turbine	Turbine building, upper level	<0.1	None
Dehumidifiers	Turbine building, upper level	<0.1	None
Ion-exchange heat exchange	Reactor building, equipment pit, upper level	0.3	None
Feedwater storage tank	Reactor building, equipment pit, upper level	<0.1	None
Dry storage pit[a]	Reactor building, along west side	<0.1	None
BORAX-V Reactor	Reactor building, north	~12.0	Co-60

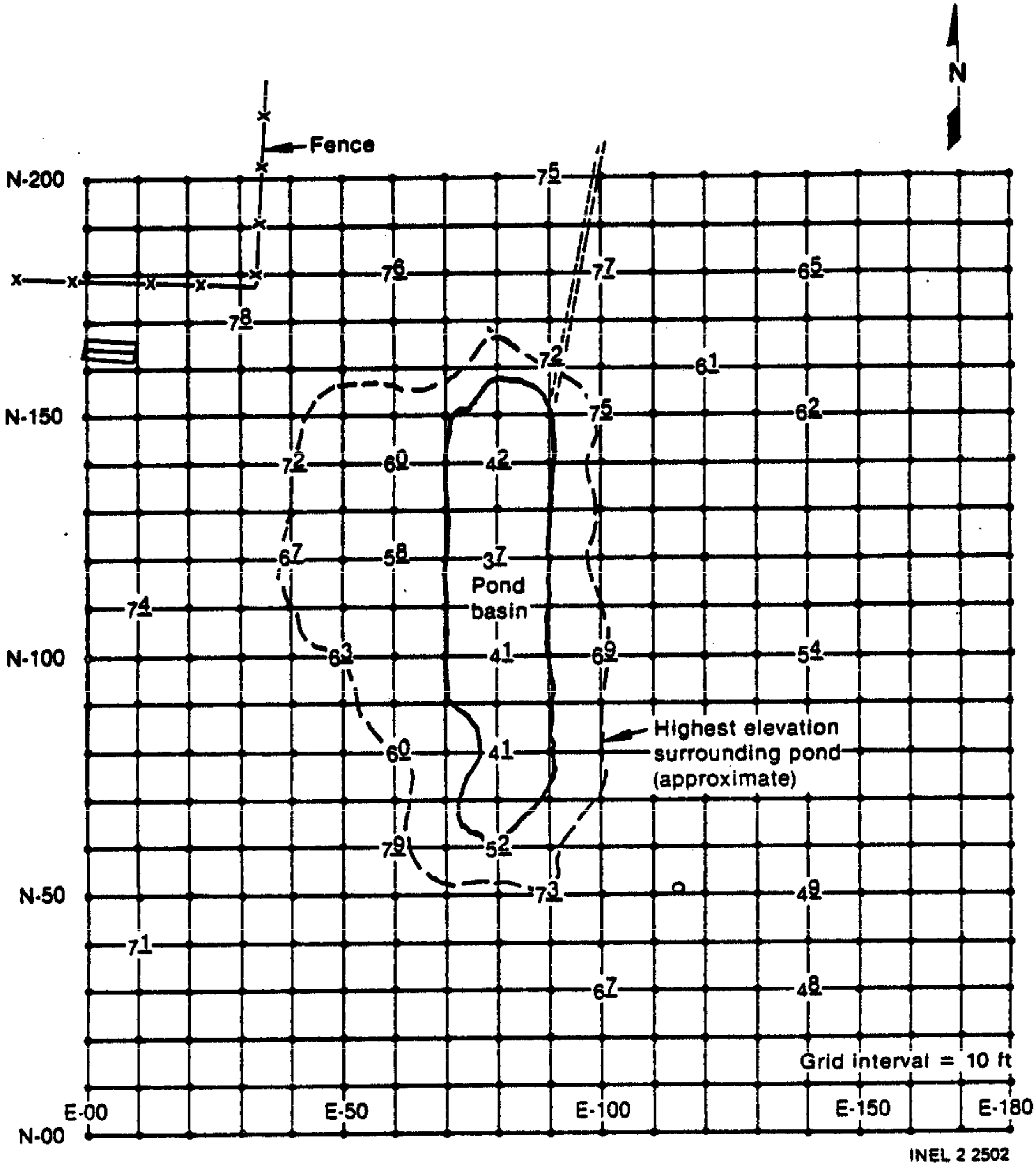


Figure 4.10.6. BORAX-V leach pond perimeter and relative elevation.

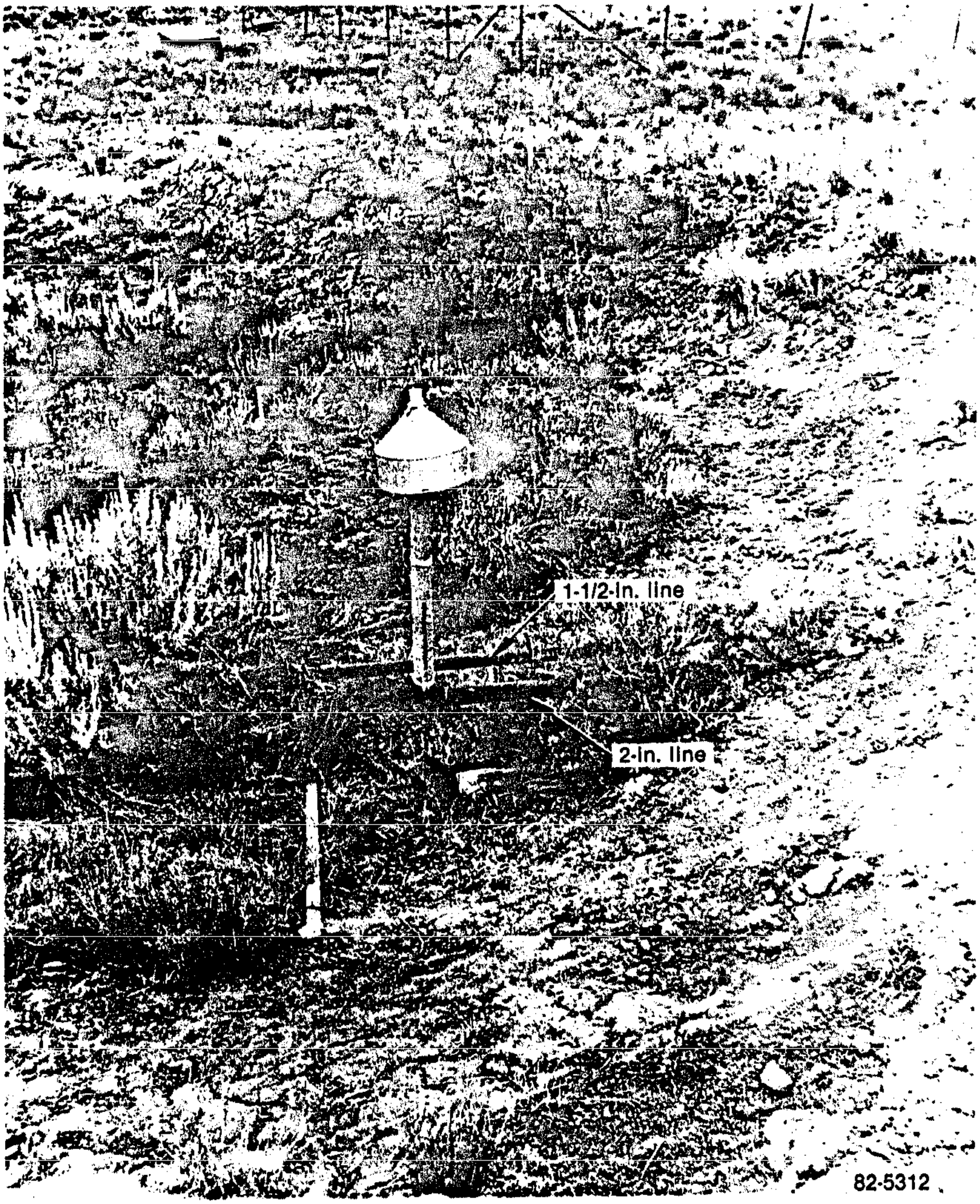


Figure 4.10.7. Wastewater pipelines to BORAX-V leach pond.

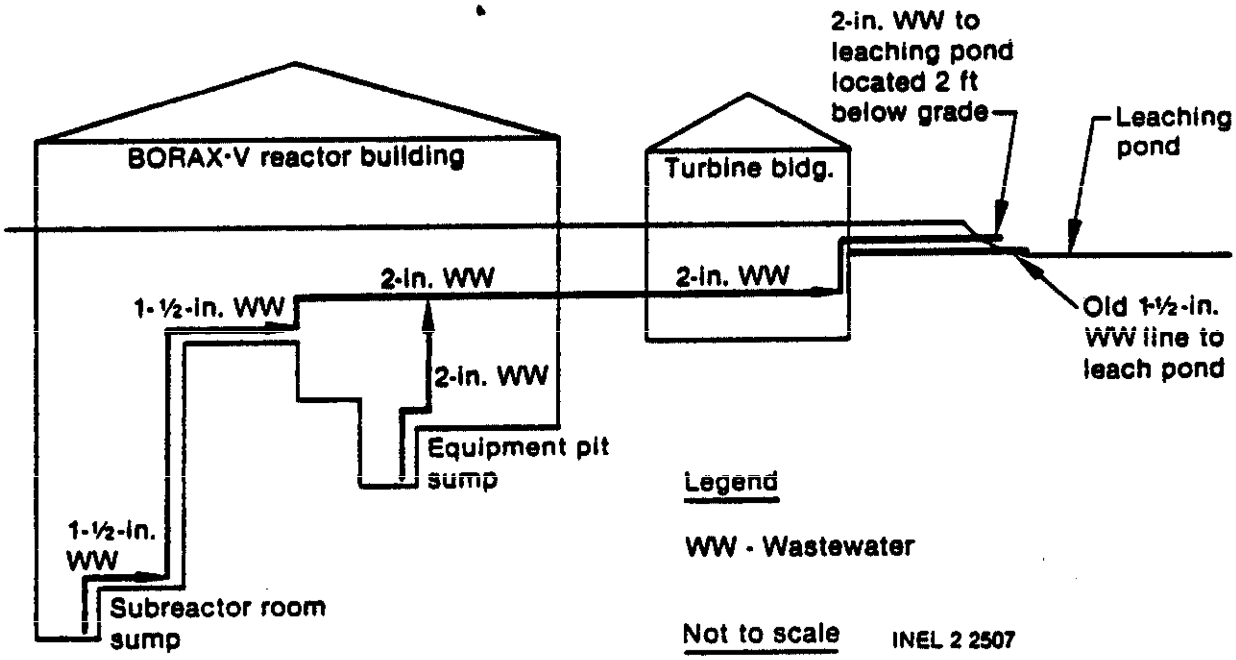


Figure 4.10.8. Wastewater pipelines to BORAX-V leach pond.

TABLE 4.10.7. BORAX-V LEACH POND TRENCH SOIL SAMPLES
(Gamma-Ray Activity)

Trench	Sample Number	Depth Below Surface (in.)	Weight (g)	Activity (pCi/g) Co-60 (1173 keV)	Cs-134 (795 keV)	Cs-137 (662 keV)	U-235 (186 keV)	K-40a (1460 keV)
A	123[a]	surface	418	--[b]	--	0.12 ± 0.03	--	19 ± 2
	123[b]	surface	483	--	--	0.3 ± 0.1	--	18 ± 2
	123[c]	surface	494	--	--	0.2 ± 0.1	--	17 ± 2
	123[d]	surface	532	--	--	0.4 ± 0.1	--	18 ± 2
	124	6	423	--	--	--	--	19 ± 2
	125	12	412	--	--	--	--	18 ± 2
	126	18	444	1.0 ± 0.1	--	1.6 ± 0.2	--	14 ± 2
	127	24	429	4.8 ± 0.4	--	175.0 ± 1.9	0.6	15 ± 2
	128	30	392	--	--	32.3 ± 0.8	--	17 ± 2
B	129	surface	466	--	--	--	--	13 ± 1
	130	6	459	--	--	--	--	15 ± 2
	131	12	413	--	--	--	--	16 ± 2
	132	18	439	--	--	0.18 ± 0.03	--	15 ± 2
	133	24	444	--	--	0.3 ± 0.1	--	12 ± 1
	134	30	444	8.3 ± 0.4	--	70 ± 1	--	14 ± 2
	(Depth-ft.)							
C	500	surface	417	--	--	0.8 ± 0.1	--	20 ± 2
	501	1	360	--	--	0.5 ± 0.1	--	14 ± 2
	502	2	507	--	--	--	--	17 ± 2
	503	3	416	--	--	--	--	17 ± 2
	504	4	587	--	--	0.17 ± 0.03	--	15 ± 2
	505	4.5	507	--	--	0.5 ± 0.1	--	13 ± 2
	506	5	550	--	--	--	--	20 ± 2
	507	5.5	516	--	--	0.3 ± 0.1	--	17 ± 2
	508	6	508	--	--	0.25 ± 0.05	--	16 ± 2
	509	6.5	509	--	--	--	--	17 ± 2
	510	7	445	--	--	--	--	16 ± 2
	511	7.5	471	--	--	--	--	15 ± 2
	512	8	547	--	--	0.16 ± 0.03	--	15 ± 2
	515	1	517	--	--	--	--	17 ± 2
	516	2	585	25 ± 1	--	36 ± 1	--	15 ± 2

TABLE 4.10.7. (continued)

Trench	Sample Number	Depth Below Surface (in.)	Weight (g)	Activity (pCi/g) Co-60 (1173 keV)	Cs-134 (795 keV)	Cs-137 (662 keV)	U-235 (186 keV)	K-40[a] (1460 keV)
C	517	3	604	--	--	1.7 ± 0.2	--	18 ± 2
	518	4	476	--	--	0.9 ± 0.1	--	18 ± 2
	519	5	454	--	--	--	--	21 ± 2
	520	6	481	--	--	--	--	16 ± 2
	521	7	417	--	--	0.18 ± 0.04	--	15 ± 2
	522	8	457	0.3 ± 0.1	--	2.8 ± 0.2	--	16 ± 2

a. K-40 is a naturally occurring radioisotope and is shown for comparative purposes only.

b. Indicates below detection limits of 0.1 pCi/g for Cs-137, Cs-134, and Co-60; and 0.5 pCi/g for U-235, using gamma-ray spectrometry analysis.

Errors (1σ) are due to counting statistics only.

TABLE 4.10.8. BORAX-V LEACH POND MISCELLANEOUS SAMPLES
(Gamma-Ray Activity)

			Activity (pCi/g)				
Number	Location	Weight (g)	Co-60 (1173 keV)	Cs-134 (795 keV)	Cs-137 (662 keV)	U-235 (186 keV)	K-40[a] (1460 keV)
121	Soil and concrete from around metal "eyes" of hatch cover		5.3 ± 0.7	--[b]	129.0 ± 3.0	--	14 ± 3
307	Rust and scale from inside 2-inch pipe outlet at pond		--	--	--	--	--
308	Rust and scale from inside 1-1/2 inch pipe outlet at pond		--	--	0.17 ± 0.02	--	--

a. K-40 is a naturally occurring radioisotope and is shown for comparative purposes only.

b. Indicates below detection limits of 0.1 pCi/g for Cs-134, Cs-137, and Co-60; and 0.5 pCi/g for U-235, using gamma-ray spectrometry analysis.

Errors (1σ) are due to counting statistics only.

The soil samples taken from Trench C were sent not only to TRA-RML for gamma ray analysis, but were also sent to EXXON Nuclear Idaho Laboratory for gross alpha, gross beta, Sr-90, U-234, -235, and -238 and Pu-238 and -239/240 for analyses. The results of these analyses are in Table 4.10.9.

For comparison, Table 4.10.10, has also been included. It contains a listing of the major manmade radionuclides found in the surface-soil samples collected from off-site areas. The concentrations listed are from samples collected during 1970 and 1975 (excluding 1972) and can be used to establish background levels of natural and fallout radioactivity.

The trench samples indicate that the contamination is contained primarily in a layer of soil one to three feet below the surface. None of the samples obtained from Trench C, which was located closest to the pipe outlet, approached the contamination levels found in trench A (175 $\pm$ 1.9 pCi/g Cs-137) or Trench B (70 $\pm$ 1 pCi/g Cs-137). The most contaminated sample in Trench C at 24 inches was 36 $\pm$ 1 pCi/g Cs-13. Except for the eight-foot sample, all samples above and below three feet were below INEL background levels.

In order to evaluate the total curies of each isotope identified from the leaching pond, the highest (or worst-case) concentrations were used as a means of calculating total curies for the whole pond. Table 4.10.11 is a result of that calculation, for a total of 5400 ft^3 (399,600 lbs) of contaminated soil.

4.10.2.6 Hazardous Waste Generated by BORAX. Due to the experiments conducted during BORAX operations, some hazardous chemicals were used in relatively small quantities. Therefore, a certain percentage of the chemicals used will appear in the wastewater line leading to the leaching pond. This is one way of investigating the probable chemical constituents in the leaching pond.

TABLE 4.10.9. BORAX-V LEACH POND SOIL SAMPLES
(alpha and beta activity)

	Activity (pCi/g)							
Sample Number	Gross Beta	Gross Alpha	Sr-90	Pu-238	Pu-239, 240	U-238	U-235	U-234
123b	11 ± 3	7 ± 2	<.1	<0.1	0.05 ± 0.03	12.1 ± 0.05	0.054 ± 0.006	1.36 ± 0.05
510	8 ± 3	5 ± 2	0.3 ± 0.1	<0.006	0.014 ± 0.003	1.10 ± 0.05	0.056 ± 0.008	1.44 ± 0.05
515	7 ± 2	5 ± 2	<0.05	NA[a]	NA	NA	NA	NA
516	60 ± 5	<2	0.19 ± 0.08	<0.006	0.032 ± 0.004	1.4 ± 0.03	0.051 ± 0.006	1.31 ± 0.03
522	8 ± 3	3 ± 2	0.14 ± 0.08	NA	NA	NA	NA	NA

Uncertainties noted are one sigma confidence level and are due to counting statistics only.

a. Not analyzed for radionuclide.

TABLE 4.10.10. BACKGROUND ACTIVITY FOR SELECT ISOTOPES

Isotope	Half-Life (years)	Geometric Average INEL Background Concentrations pCi/g
Co-60	5.26	--b,d
Sr-90	27.7	0.54[a] x/÷1.1
Cs-134	2.05	--b,d
Cs-137	30	0.94[a] x/÷1.2
Pu-238	86.4	0.0028[a] x/÷1.2
U-235	7.1×10^8	0.05[c] ±0.005

a. From 1980 Environmental Monitoring Program Report for Idaho National Engineering Laboratory Site, IDO-12082 (80), May 1981, for samples taken in 1970-1975 but excluding 1972.

b. Indicates samples were below detection limit of 0.01 pCi/g based on 1000 minute count of a 600 g sample.

c. From PM-2A Radiological Characterization, Internal Technical Report, PR-W-80-018, August 1980.

d. From Decontamination and Decommissioning - Long Range Plan - Idaho National Engineering Laboratory, Internal Technical Report, PR-W-79-005, Revision 2.

TABLE 4.10.11. TOTAL CURIES CALCULATED FOR EACH ISOTOPE IDENTIFIED FROM BORAX-V LEACHING POND[a]

Isotopes	Worst-Case Concentration (pCi/g)	Total Ci
Cs-137	175.0	3.2×10^{-2}
Co-60	25.0	4.5×10^{-3}
Sr-90	0.3	5.4×10^{-5}
Pu-239, 240	0.05	9.1×10^{-6}
U-234	1.44	2.6×10^{-4}
U-235	0.056	1.0×10^{-5}
U-238	1.43	2.5×10^{-4}
Unidentified Alpha	7.0	1.3×10^{-3}
Unidentified Beta	60.0	1.1×10^{-2}

a. Assuming 1.81×10^8 grams of contaminated soil in the pond.

In the experiments at BORAX-III, the steam was collected and fed directly to a turbine. It therefore lent itself to the study of water decomposition rate as a factor of addition of certain chemicals. The results of this study are given below.

Addition	Rate of Change in Water Decomposition
KCl, 4 gm	Increased 10%
NH_4OH, 4 cc	Increased 10%
N_2, 166 cc/L of condensed steam	No effect
O_2, 26 cc/L of condensed steam	Slight increase
KOH	Decreased as pH increased
H_2	Decreased in proportion to rate of addition

Another study was made on BORAX-III in 1956, to observe the changes which occur in Hotwell activity when chemicals are added to the feedwater. The results of this study are given in Table 4.10.12.

Similar studies of water decomposition were made for BORAX-IV by observing the effect of adding chemicals to water.

- <u>Addition of phosphoric acid</u>: A preliminary two-day test was made in BORAX-IV to study the effect of H_3PO_4 on water decomposition and activity in reactor steam systems. H_3PO_4 was added at intervals in five portions until a total of 201 cc had been added (47.7 ppm PO_4^{-3}).

TABLE 4.10.12. CHANGES IN HOT WELL ACTIVITY RESULTING FROM ADDITION OF CHEMICALS TO FEEDWATER

Date	Addition	Amount	Activity, mR/hr Before Addition	Peak After Addition	Delay Time to Peak Activity (Minutes)
3-9	KCI	4 gm	70	125	2
3-11	HCI	6.8 cc (conc.)	150	225	15
3-11	NH_4OH	2 cc (conc.)	73	180	1.75
		4	100	240	1.1
		4	65	225	1.25
3-11	HNO_3	1.9 cc (conc.)	62	130	9
		1.9	80	160	8
		6.0	50	290	10
3-16	NH_4NO_3	1.2 gm	95	200	5
3-16	N_2H_4	1 cc (anhydrous)	90	95	
		10	95	310	2
2-16	H_2SO_4	5 cc (conc.)	200	270	8
3-17	H_2O_2	5 gm	No Increase		
		9	No Increase		
3-15	KOH	2 gm	80	60	6
		2	65	55	5
		2	50	50	
		6	50	50	
3-12	N_2 (gas)		No Increase		
3-14	O_2 (gas)	26 cc/L	100	70	5
		50	70	45	
3-13	H_2 (gas)		75	230	20 sec
3-14			80	170	27 sec
3-17		27 cc/L	90	160	15 sec

- Addition of Morpholine: A total of 5 ppm were used to study water decomposition.

4.10.2.6.1 Suspended and Dissolved Solids from BORAX-V--Corrosion products at the surface of materials are in contact with the primary coolants. Since water-cooled nuclear reactor systems are constructed mainly of an 18-8-type stainless steel, the corrosion products contain the elements found in these steels, i.e., iron, chromium, nickel silicon, and carbon.

Typical suspended insoluble solids measured in boiling core B-2 and in cores PSH-1A and 1B are compared in Table 4.10.13.

Further information on the major corrosion products formed and collected from the boiling zone of the reactor during this operation period was derived from the analysis of a sample of material taken from the cellulose filters upstream of the reactor-water demineralizer after about 30 days of operation. Table 4.10.14 shows the major components present in this material.

4.10.2.6.2 Boron Addition in BORAX--Boron in the reactor vessel water has the same type of poisoning or neutron-absorbing effect as do the reactor control rods. When introduced into an actively steaming vessel, only a very small amount of boric acid is carried away in the steam; most remains in the vessel water.

A charge of approximately 130 kg (dry wt.) of boric acid was calculated to be adequate for most BORAX core loadings and maximum water load with forced convection piping in place.

4.10.2.6.3 Regeneration of Ion-Exchange Columns--From BORAX-III to BORAX-V, the purification system (which included both an ion-exchange column and a mixed bed) had to be regenerated occasionally. Sulfuric acid and sodium hydroxide were used. The total discharge from this regeneration was approximately 454 kg/y for the acid and for the base.

TABLE 4.10.13. SUSPENDED INSOLUBLE SOLIDS, COMPARISON OF CORE B-2 WITH CORES PSH-1A AND PSH-1B

Sample Period	Concentrated Ignited Solids, ppm	Average Analysis, w/o	Remarks
1963		Core B-2	
Jan 30 to Feb 1	0.02	Fe: 20.4	System hot. Various
Feb 6 to Feb 8	0.08	Cr: 1.2	powers from 0 to 20
Feb 8 to Feb 13	0.08	Ni: 3.7	MWt. Sampled with
		Al: 41.0	midvessel probe.
Date and Time, 1964		Cores PSH-1A and PSH-1B	
June 22 (1000) to June 23 (0830)	0.09		
June 23 (0850) to June 23 (1303)	0.03		
June 23 (1355) to June 23 (1500)	0.83		DM-1 off from 1352 to 1418. $Al(NO_3)_3$ injected at 1410.
June 23 (1510) to June 23 (1840)	2.5		
June 24 (0850) to June 24 (1500)	0.009	Fe: 20.0	Average suspended
June 24 (1509) to June 26 (1100)	0.008	Cr: 1.9	solids analysis
		Ni: 1.3	includes $Al(NO_3)_3$
		Al: 32.0	injection.
June 26 (1115) to June 26 (1600)	0.002		
July 6 (1600) to July 10 (0930)	0.006		
July 10 (1020) to July 10 (1240)	0.001		
July 10 (1245) to July 10 (1545)	0.001		
July 13 (1400) to July 15 (0900)	0.080		
July 15 (0900) to July 16 (0900)	0.003		

TABLE 4.10.14. ANALYSIS OF SOLIDS FROM CELLULOSE FILTER UPSTREAM OF REACTOR-WATER DEMINERALIZER, CORE PSH-1A

Compounds: (mostly amorphous)	Elements, w/o:			
Major ones identified:	Al:	15	Cu:	0.1
	Fe:	10	Zn:	0.1
Bayerite - $Al(OH)_3$	Ni:	3	V:	0.05
	Cr:	1	Sn:	0.05
Silica - SiO_2	Si:	1	Zr:	0.02
	Pb:	1	Ti:	0.02
Iron Oxide - Fe_2O_3 (hydrated)	Mn:	0.5	B:	0.01
	Mg:	0.3	Ag:	0.001

4.10.2.6.4 Chemical Decontamination--Laboratory studies were made to evaluate decontamination methods that may be useful in boiling water reactor systems. A recommended procedure for the decontamination of metal contamination by using high-pressure steam involves the use of alkaline permanganate; the chemical formula consists of NaOH (100 g/L), $KMMO_4$ (30 g/L), H_2O (870 g/L), and citric acid.

4.10.2.6.5 Hazardous Materials Presently Observed from BORAX-V--Asbestos: Steam piping throughout the BORAX-V facility is wrapped in several inches of insulation (see Figure 4.10.9). Samples of this insulation were collected and analyzed at the Hanford Environmental Health Foundation and were found to contain asbestos (see Table 4.10.15). The asbestos pieces were located as part of a dump, behind the reactor building. This dump has now been cleaned up and the asbestos has been boxed and buried at the central landfill.

PCB: There is a possibility that the turbine lube oil and the liquid dielectric in the electrical transformer contained the toxic material PCB. According to the Waste Management D&D Program of EG&G, one of the tanks, V-2 from TAN, which contained dielectic*** liquid was tested and confirmed the presence of PCB (500 ppm). Since the electrical transformers at the TAN and BORAX facilities were of the same time frame, and same design, we assume the same type of dielectric liquid was used.

Lead: Lead pieces were observed throughout the BORAX-V facility. The largest, shown in Figure 3.10.10, was about 9 ft^3.

Chromium: Chemical analyses on the BORAX-V cooling tower were completed in May of 1979 by D&D. The analyses were conducted in order to determine the presence of wood-preservative chemicals. Each sample was analyzed for hexavalent, and total chromium, arsenic, trichlorophenols and penta-chlorophenol. The results of the analyses indicated that most chemical concentrations were at or below detection limits. See Table 4.10.16.

TABLE 4.10.15. ASBESTOS ANALYSIS FROM BORAX-V FACILITY

Sample	Fiber Content
#1 Pipe @ Top	15-25% Amosite Asbestos 20-30% Chrysotile Asbestos 20-30% Cellulose
#2 East Side	30-40% Amosite Asbestos 15-25% Chrysotile Asbestos
#3 Center	30-40% Chrysotile Asbestos

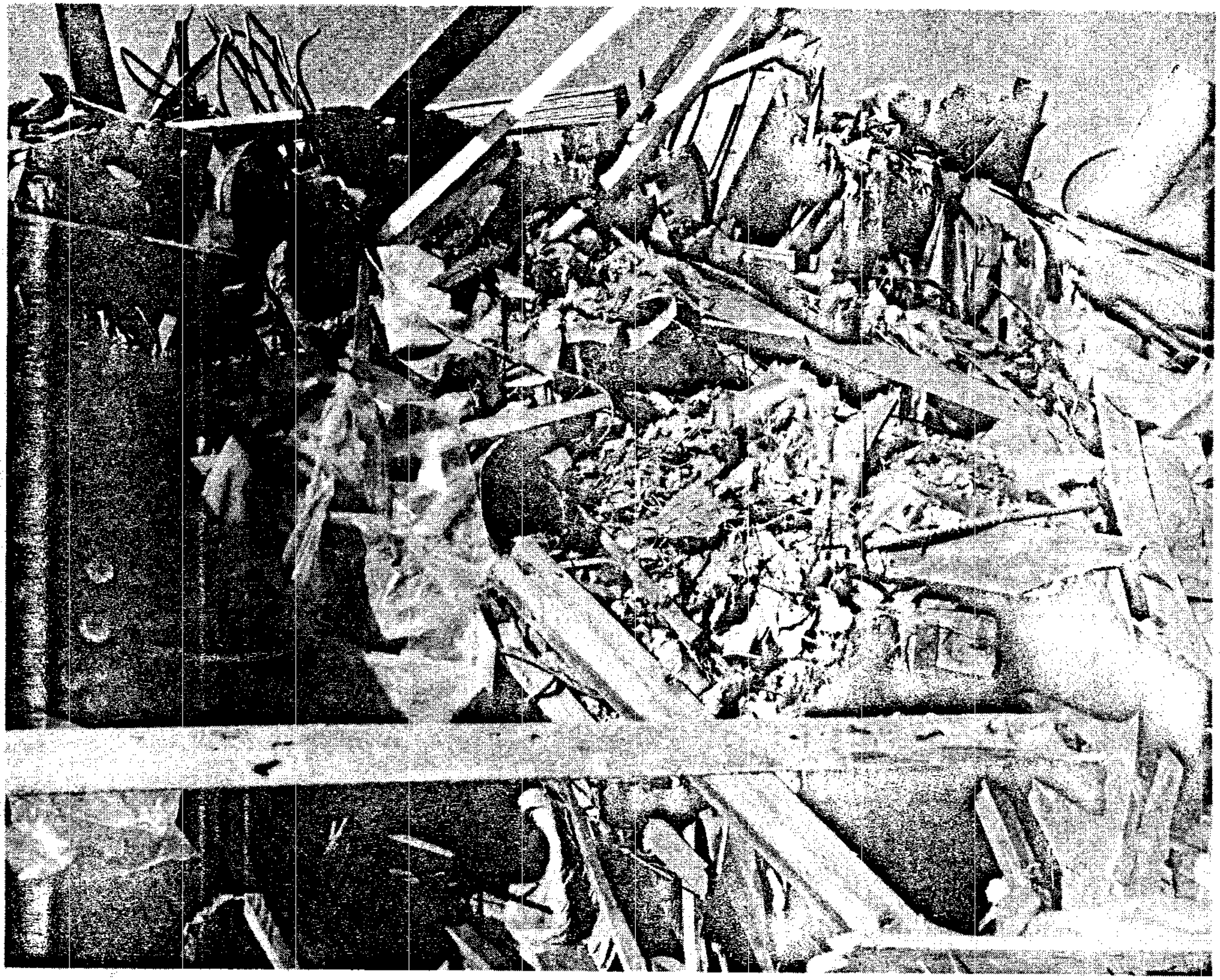


Figure 4.10.9. Asbestos piping insulation in BORAX-V waste dump.

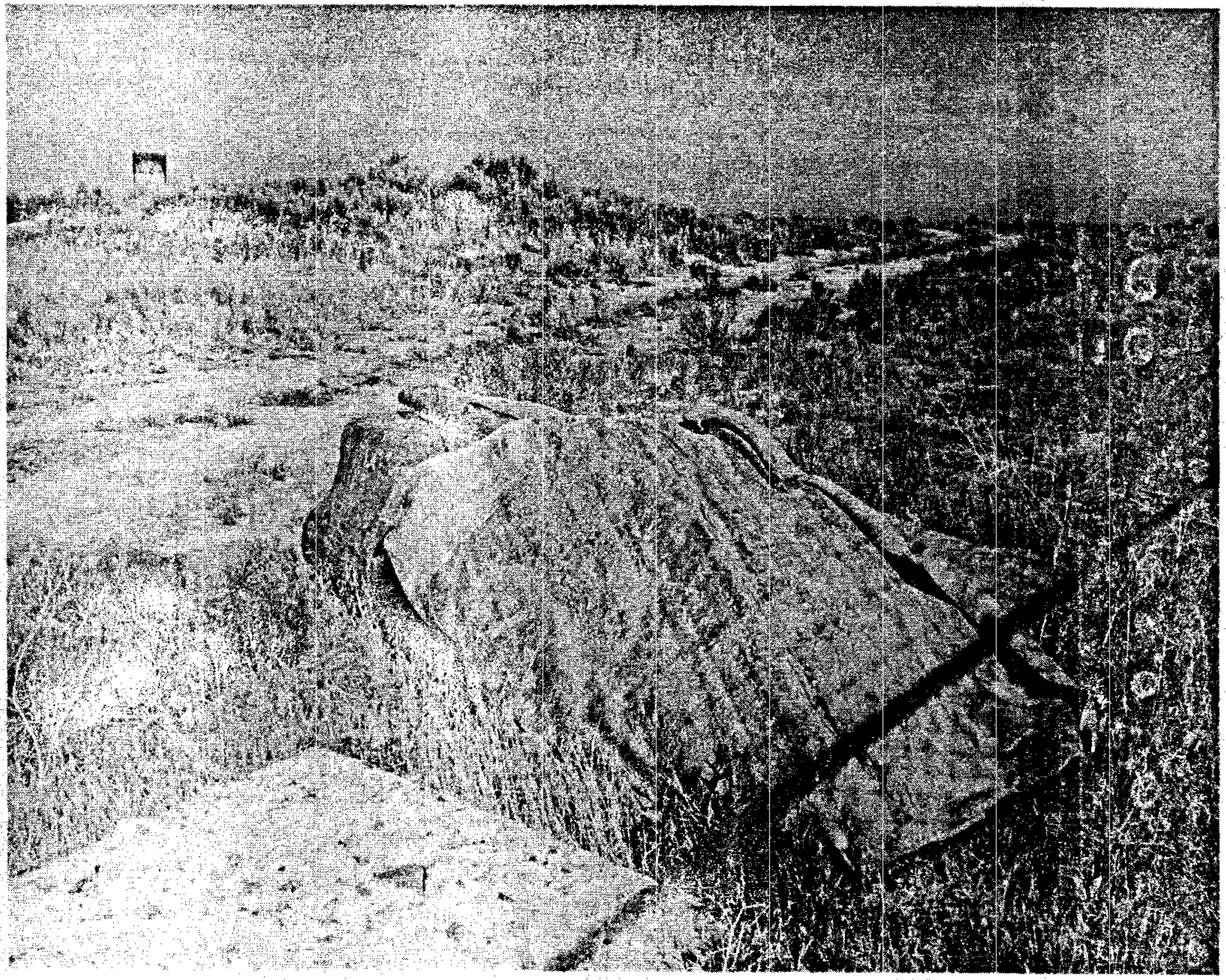


Figure 4.10.10. Lead waste (9 ft^3).

TABLE 4.10.16. CHEMICAL ANALYSIS ON BORAX-V COOLING TOWER WOOD SAMPLE

Field Sample Number	UBTL Lab Number	Sample Type	Results		
			% CHROMIUM		% ARSENIC
A-2	4802	Bulk	29.3	0.0003	<0.001
B-2	4803	Bulk		0.0002	<0.001
C-2	4804	Bulk		0.0001	<0.001
Limit of detection				0.0001	0.001
			ppm 2,4,5 TRICHLOROPHENOL 2,4,6		PENTACHLOROPHENOL ppm
A-3	4805	Bulk	<2.5	<1.0	<16
B-3	4806	Bulk	<2.5	<1.0	<16
C-3	4807	Bulk	<2.5	<1.0	<16
	LOD		2.5	1.0	16

Tables 4.10.17 and 4.10.18 summarize the total waste generated by the BORAX facility. Table 4.10.17 shows the total curies for radioactive waste generated, while Table 4.10.18 characterizes the nonradioactive wastes, which include sulfuric acid and sodium hydroxide, with their respective quantities in kg or liters per year.

TABLE 4.10.17. RADIOACTIVE WASTE AT BORAX FACILITIES

Facility	Waste Streams	Time Frame	Estimated Quantities (Total Curies)	Treatment/ Storage/ Disposal
BORAX-I	No data available	1953-1954		
	Destruction (contaminated soil)	7/22/54	CS-137: 37.07	Buried and graded
BORAX-II	No data	1954-1955	--	--
BORAX-III	Liquid	1955-1956	10	Ion exchange/ treatment leaching pond
	Solid	1955-1956	--	
	Gaseous	1955-1956	--	RWMC
				Atmosphere
BORAX-IV	Liquid	1957-1958	CS-137: 0.01 Sr-90: 0.0041	Leaching pond
	Solid		--	RWMC
	Gaseous		4565	Atmosphere
BORAX-V	Liquid	1958-1964	0.104	Leaching pond
	Solid		1800	RWMC
	Gaseous		7813	Atmosphere

TABLE 4.10.18. NON-RADIOACTIVE WASTE AT BORAX FACILITIES

Facility	Waste Streams	Time Frame	Estimated Quantities	Treatment/ Storage/ Disposal
BORAX-I -III -V	H_2SO_4	1955-1964	454 kg/yr	Dispose of in diluted form to leaching pond
	NaOH	1955-1964	454 kg/yr	Same as above
	Boric Acid	1955-1964	90.8 kg/yr	Same as above
BORAX-IV	Morpholine	1957	0.095 kg/yr	Leaching pond
BORAX-V	PCB	1955-1964	--	
	Chromium	1955-1964	--	
	Asbestos	1955-1964	--	Piping insulation in the BORAX facility

4.11 Experimental Breeder Reactor-I (EBR-I) Past Activity Review

4.11.1 EBR-I Description

The Experimental Breeder Reactor-I/Waste Management Office (EBR-I/WMO) area is located on the INEL site, southwest of the Central Facilities Area. Figure 4.11.1 shows the present plot plan of EBR-I/WMO area.

The EBR-I was designed in the period 1948 to 1950. It was designed to prove: (1) The concept of breeding by actual measurement (by making measurements after radiation of fuel by chemically reprocessing it and then arriving at values), and (2) the concept of cooling a reactor with liquid metal and using the heat in the production of steam.

The reactor was built in 1951, went critical that fall, and produced the first useful power in December of 1951. The Mark I-IV series cores were developed and tested over a ten-year period. In 1964 the reactor shut down because of lack of further assignments.

A flow diagram of the heat transfer system is shown in Figure 4.11.2. Primary and secondary coolant circuits are used in series. Both the primary (or reactor) circuit and the secondary (or steam generator) circuit use sodium-potassium alloy (78 wt 90 K). The coolant flow path is as follows:

> The alkali metal was pumped from the sump tank to a head tank as shown in Figure 4.11.2. The metal flowed by gravity from this head tank through the reactor then through an intermediate heat exchanger to return to sump tank. The heat produced was then transferred to the steam generator, which in turn, powered a turbine-generator.

The Argonne Fast Source Reactor shielding (AFSR) was developed as a tool to study the physics of fast breeder reactors. It was placed in operation in October 1959, with a design power of one kilowatt. The AFSR was located southeast of ZPR-III building. The original AFSR building had

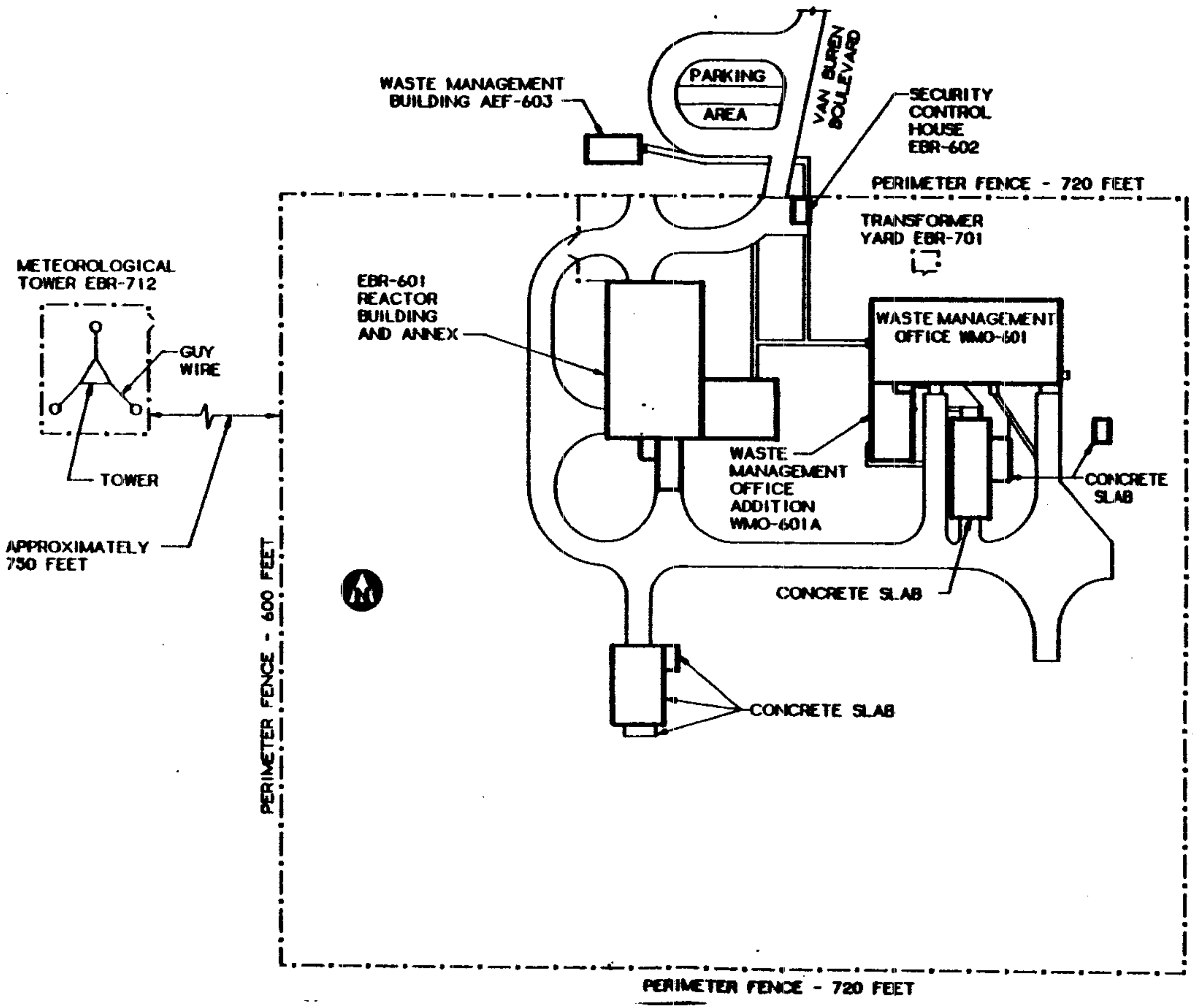


Figure 4.11.1. EBR-I/WMO plot plan.

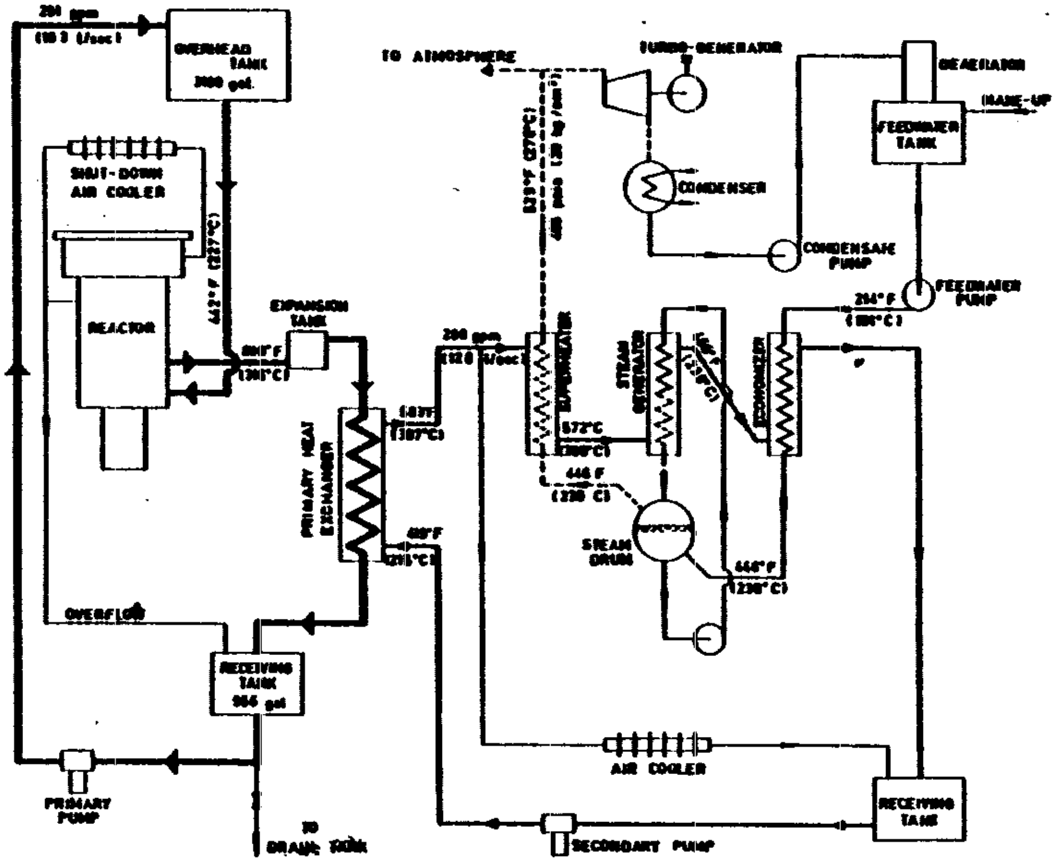


Figure 4.11.2. Flow Diagram, EBR I Reactor.

been dismantled and the reactor, control instrumentation, and electrical gear had all been removed to EBR-II prior to initiation of the EBR-I D&D program. Remaining were the belowgrade basement, source storage vault and hardware, the abovegrade steel-lined concrete shielding structure with view port and access ports to the centrally located reactor cell shown in Figure 4.11.3.

4.11.2 EBR-I Condition Prior to Decommissioning

The Experimental Breeder Reactor main building is a multilevel structure, which consists of basement, main floor level and the mezzanine. Basic floor plans are shown in Figures 4.11.4, 4.11.5 and 4.11.6 respectively.

In addition to housing the reactor, its associated controls, cooling and power generation system office, heating, utility and maintenance provisions, the building housed facilities and equipment for handling storage and wash-down of nuclear fuel elements. Consequently, even though all nuclear elements were removed from this facility many years ago, some areas of the building remained radioactive. These activated and/or contaminated areas included the reactor core area, the fuel rod farm, fuel handling, storage, and wash-down areas, and the conveyor area below the reactor. In addition, the primary coolant system, containing 4,400 gal of NaK, had been radioactively contaminated by the core meltdown that took place in 1955. At the time that the facility was deactivated, both the primary and secondary NaK systems had been drained into their respective drain tanks, 4,400 gal of radioactively contaminated NaK in the primary drain tank and 1,100 gal of uncontaminated NaK in the secondary drain tank. Observations at the reactor tank showed evidence of oxide residue over the NaK, which might have been caused by air and moisture in the system. (In 1970, analysis showed a total Cs-137 contamination of 16.2 curies and 2.1 mCi of Sr-90.)

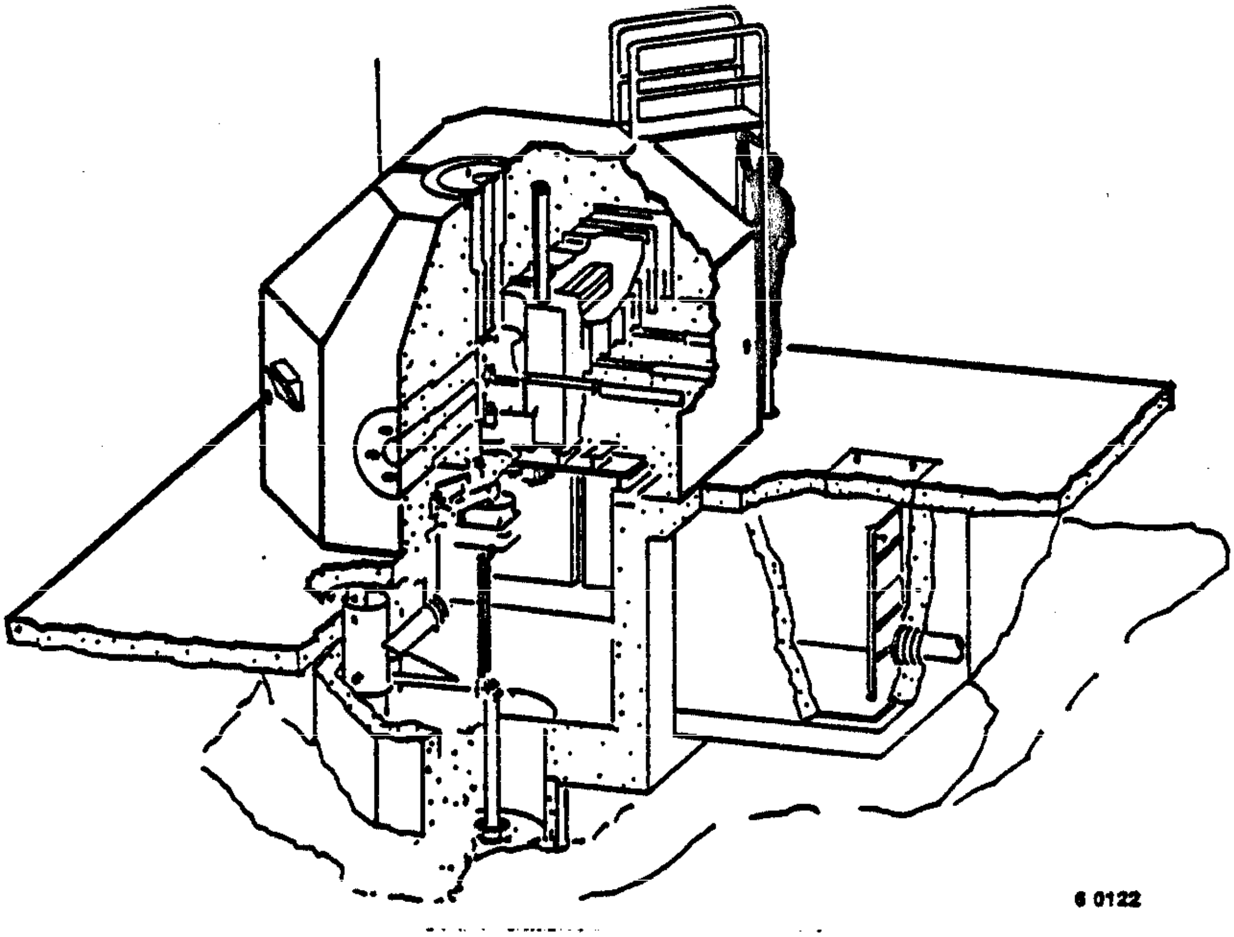


Figure 4.11.3. AFSR shielding.

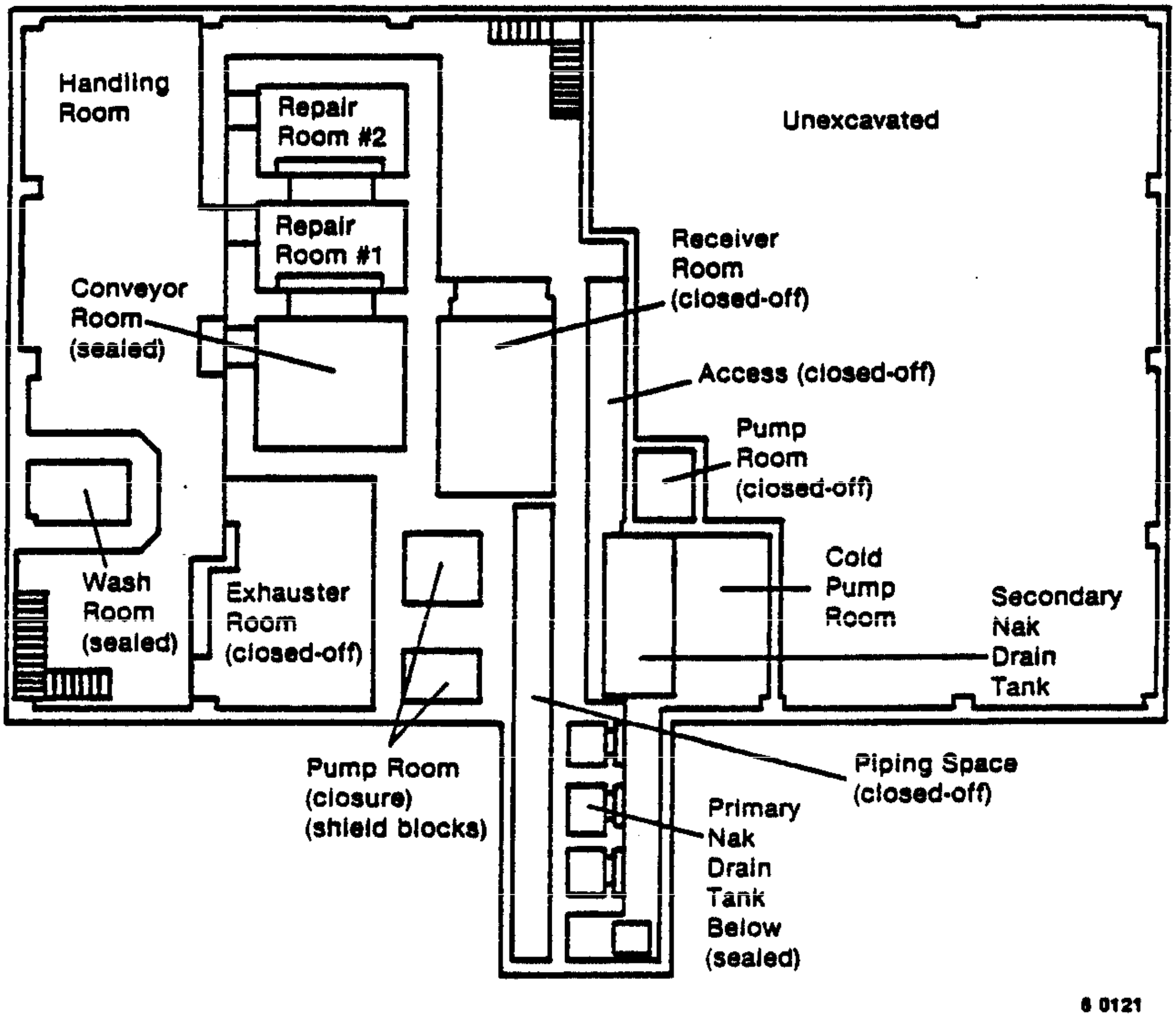


Figure 4.11.4. EBR-I basement plan.

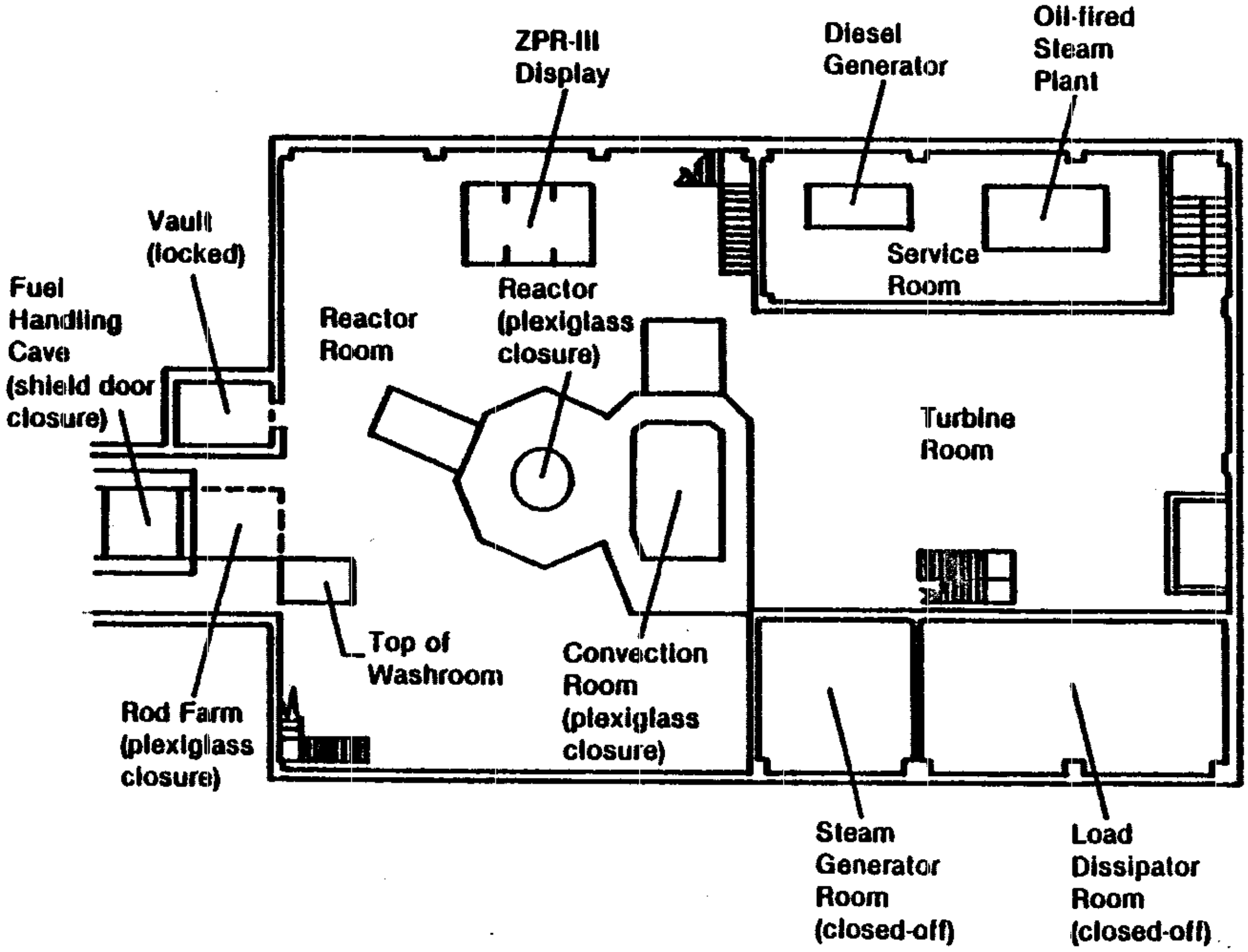


Figure 4.11.5. EBR-I main-floor plan.

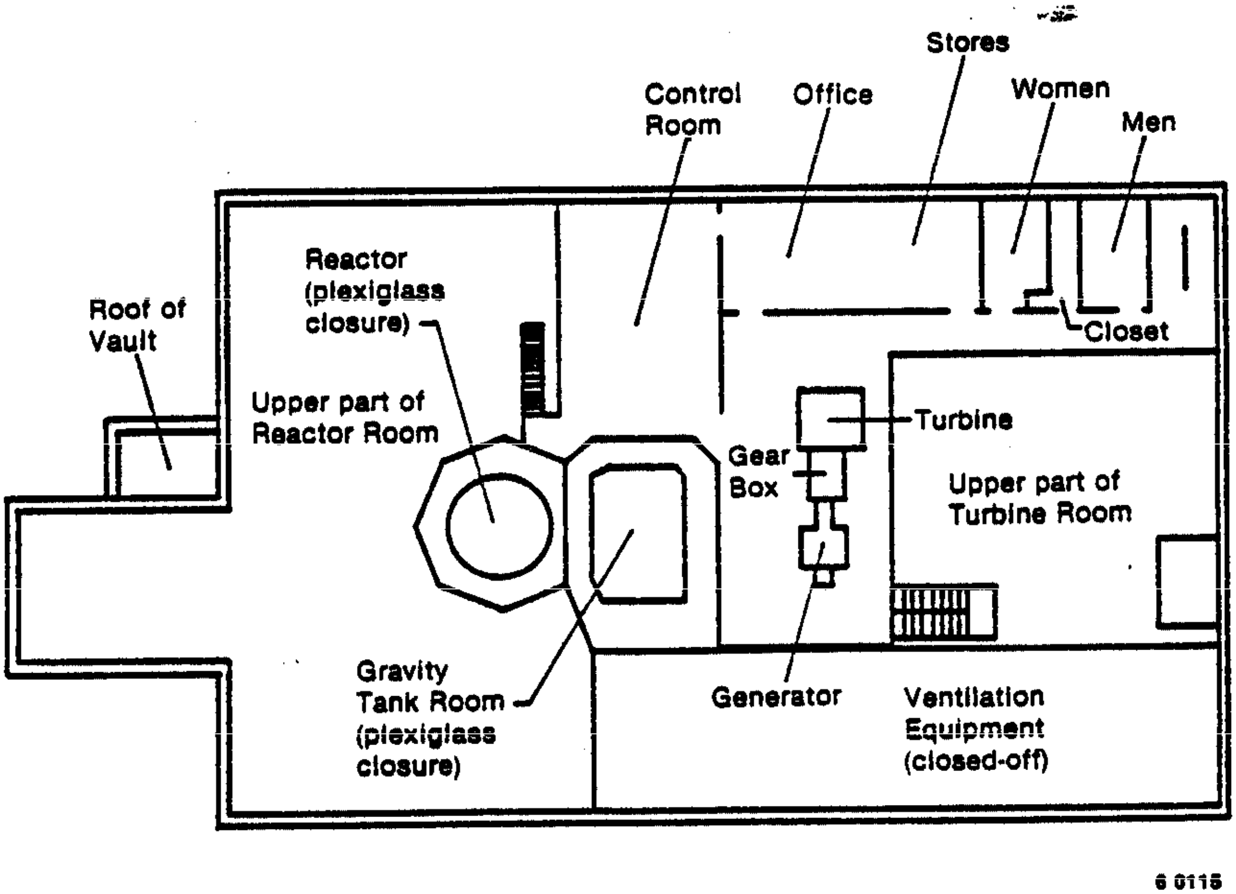


Figure 4.11.6. EBR-I Mezzanine plan.

4.11.3 Decontamination and Decommissioning of the EBR-I Complex

The purpose of the EBR-I Complex Decontamination and Decommissioning (D&D) Program was to make the EBR-I Complex safe for use and enjoyment by the public as a National Historical Monument. The complex consists of the EBR-I Reactor Building, the Zero Power Reactor Building (ZPR-III), the Argonne Fast Source Reactor (AFSR), and the contaminated NaK Storage Pit.

The D&D Program for the EBR-I complex included:

- Extraction of 5,500 gal of NaK coolant which were left in the reactor primary and secondary coolant loops
- Conversion of the NaK to a solid caustic (KOH/NaOH) for drummed waste disposal at the RWMC
- Decontamination of all NaK and/or radioactive contaminated equipment of the complex
- Demolition and removal of the portion which could not be decontaminated to safe levels
- Decontamination and removal of the ZPR-III Reactor
- Demolition of the AFSR shielding
- Removal of contaminated NaK in the NaK storage pit
- Removal of all nonradioactive debris to the INEL Central Facility Area (CFA) sanitary landfill
- Performance of final surveillance and safety inspection to ensure the safe condition of the entire EBR-I complex.

The D&D work was initiated in October 1973, and the U.S. National Park Service was given beneficial occupancy of the building May 27, 1975. All D&D work was completed by June 13, 1975. The final radiation survey report was issued after completion of D&D. See Table 4.11.1 for comparison to pre-decontamination of the EBR-I complex.

4.11.4 Waste Generated by D&D Activity

4.11.4.1 NaK Process Plant. The 5500 gal of NaK were disposed of by reacting it with water in a strongly basic solution (NaOH/KOH), solidifying the solution by evaporation and cooling and disposal of the solid waste at the INEL RWMC.

The NaK process plant is shown in Figure 4.11.7. The NaK was reacted with water in the caustic in the VFE-I vessel to produce additional caustic. Water was injected into the vessel to make up for the water consumed by the NaK and for vaporization of water in the vessel. The off-gas from the vessel was passed through a demister, a scrubber vessel and a knock-out vessel. It then passed through one of two filter limits, each of which contained a glass wool or a steel wool prefilter and a particulate (HEPA) filter. The off-gas was sampled and then passed through a flare stack containing a flame arrester. Condensate, which formed in the off-gas line, was continuously drained and periodically recycled to the VFE-I vessel. The product from the VFE-I vessel was drained into 55-gal drums which, after solidification, were shipped to the RWMC.

To clean up the final traces of NaK, moist gaseous nitrogen (GN_2) was passed through the NaK feed tanks and lines followed by a water rinse. Finally, the residual liquid was evaporated until a 25-M concentration was attained for solidification and disposal.

The flowsheet for the NaK conversion is shown in Table 4.11.2. The conversion apparatus was designed to react 125 L/hr of NaK with the caustic solution to form the mixed NaOH/KOH solution. Water was to be conserved by

TABLE 4.11.1. RADIATION SURVEY--EBR-I

Area	General Field mR/hr	Contact mR/hr	Smear d/m/100 cm^2		Remarks
			βγ	α	
Filter tank room	0.5 R/hr	20.0	--	--	piping and tank
Gravity tank room	3.0	12.0	100	25.0	tank
Convection loop room	50.0	190.0	210	<20.0	--
Cave rails	--	80.0	4,890	<10.0	spot reading
Cave	--	0.7	6,700	4.5	Manipulators
Rod farm	--	--	<250	<10.0	--
Rod holes	--	--	11,380	4.5	--
Nest cell	--	--	640	<20.0	--
Middle cell	2.0 R/hr	10.0 R/hr	1,970	169.0	at contact with ^{238}U Cup.
Elevator cell	90.0	1.5 R/hr	--	--	9 ft high in the center
Elevator cell	60.0	--	--	--	at the door
Decon cell	10.0	3.0	11,400	30.0	at the door
Decon cell	--	100.0	--	--	wash tubes
Ventilator room	--	--	840	240	middle ventilator
Sub pile room	--	--	700	<20	--
T_2NaK receiving tank room	5.0	40.0	--	--	at the tank
T_2NaK receiving tank room	0.5	--	--	--	at the tank
NaK to NaK heat exchanger room	15.0	100.0	--	--	heat exchanger
NaK to NaK heat exchanger room	1.0	--	--	--	at the door
Secondary NaK pump/dump room	3.0	--	--	--	entrance to corridor leading to primary dump room
Secondary NaK pump/dump room	--	5-45.0	--	--	pipes near ceiling
Secondary NaK pump/dump room	--	80.0	--	--	primary pump
Primary NaK dump tank	200.0	250.0	--	--	tank

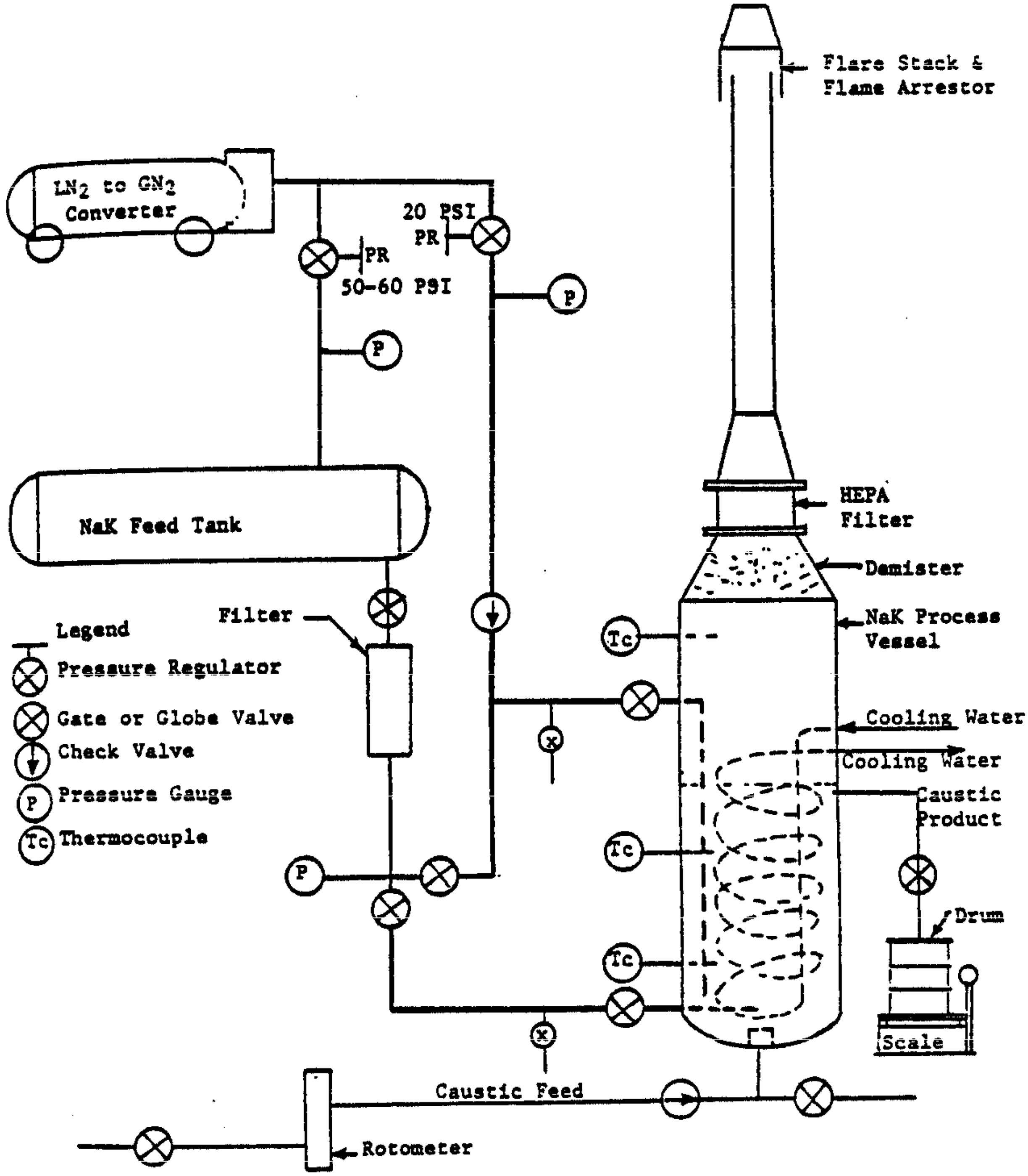


Figure 4.11.7. Process flow diagram of the EBR-I NaK Process Plant.

TABLE 4.11.2. FLOWSHEET FOR NaK REACTION

	NaK Feed	Water Addition	Caustic Produced	Off-Gas
Flowrate	125 P/hr	255 P/hr	128 P/hr	172 scfm
NaK, M	25.6	--	25	--
H_2 Vol. %	--	--	--	12%
H_2O (vapor) Vol. %	--	--	--	83%
GN_2 Vol. %	--	--	--	5%

reaction with NaK and by vaporization at a rate of 252 L/hr. The caustic product at 25 M was to be removed periodically at an average rate of 128 L/hr.

From analysis of primary system NaK and the caustic product, the primary system NaK process was found to contain 16.2 Ci of Cs-137 and 2.1 μCi of Sr-90. There were no other radioactive nuclides found. The estimated release of Cs-137 to the atmosphere was 0.9 μ Ci. The estimated release of Sr-90 was approximately 0.1 μCi.

Similarly, the 93 full or partially full drums filled during disposal of the EBR-I primary system NaK were shipped to the RWMC after solidification of the caustic.

During the last stages of processing of EBR-I, the contents of the scrubber and knock-out vessels were pumped into the VFE-I vessel. Two partially full 58-gal drums containing condensate from the stack were shipped to ICPP for disposal as a liquid waste.

After all NaK processing was completed, all of the processing equipment was dismantled and removed to the RWMC for disposal.

4.11.4.2 Isolation of Unclaimed Area. It was neither possible nor practical to decontaminate some areas in building EBR-60, to safe levels. These areas included the fuel rod farm, fuel wash room, and the areas containing the elevators, the reactor cell, and the primary NaK drain tank. Since these areas could not be satisfactorily decontaminated, isolation walls or barriers were constructed to prevent entry.

After NaK removal and flushing out of the EBR-I NaK systems had been completed, there remained approximately 80 gal of contaminated caustic sludge at the bottom of the primary drain tank. This residual sludge was not readily removable through the normal system fill or drain lines. It was therefore decided to solidify the residue in place in the tanks, seal up the tank, and isolate the area to prevent entry.

4.11.4.3 NaK Storage Pits. The NaK storage pit, the drums of residual NaK stockpiled along the west fence line, and miscellaneous useless equipment had to be disposed of. The four packages of contaminated NaK were located in the NaK storage pit, approximately 100 ft west of EBR-601. They included two 55-gal drums and two specially fabricated containers which were partially filled with the NaK present in the reactor at the time of the partial core meltdown in November 1955. Radionuclide analysis showed that the NaK was highly radioactive and contained uranium, plutonium, and potassium superoxide. The containers and contents were removed from the NaK storage pit and transported to the Army Re-entry Vehicle Facility Site (ARVFS) bunker for temporary storage. The NaK storage pit was found to be uncontaminated, after removal of the drums and containers. Therefore, after the removal of the packages, the pit walls and concrete pad were demolished and backfilled into the pit. Further backfill to grade level was completed with native soil.

4.12 Zero Power Reactor-III (ZPR-III)

ZPR-III was used for determining the accuracy of predicted critical mass geometries and to determine critical measurements in connection with various loadings for make-up of fast reactor core design. The cores of EBR-II, Fermi, Rapsodie, and SEFOR reactors were originally mocked-up in this facility.

The ZPR-III Building (now WMO-601) is situated approximately 74 feet east of EBR-I. The basic building flow plan is shown in Figure 4.12.1.

4.12.1 Waste Generated by ZPR

Liquids: There were no radioactive liquid wastes or industrial liquid wastes produced in this facility. The sanitary waste effluent was discharged through a cast-iron pipe to a septic tank and leaching bed.

Solids: The major source of radioactive solid waste was from wipe rags, plastic containers, shoe covers, and other industrial solids associated with contact with radioactive materials. These were packaged and transported to the NRTS burial ground for disposal.

Solid nonradioactive waste was segregated into combustibles and noncombustibles. The combustibles were disposed of in the NRTS incinerator, and the noncombustibles were stored for future disposition.

The characterization of the effluent from the ZPR-III waste was generalized in conjunction with the effluent from EBR-I, and BORAX. These discharges are summarized in Tables 4.12.1 through 4.12.5.

ZPR-III releases consisted of fission-product noble gas originating in the V-235 and depleted-uranium fuel.

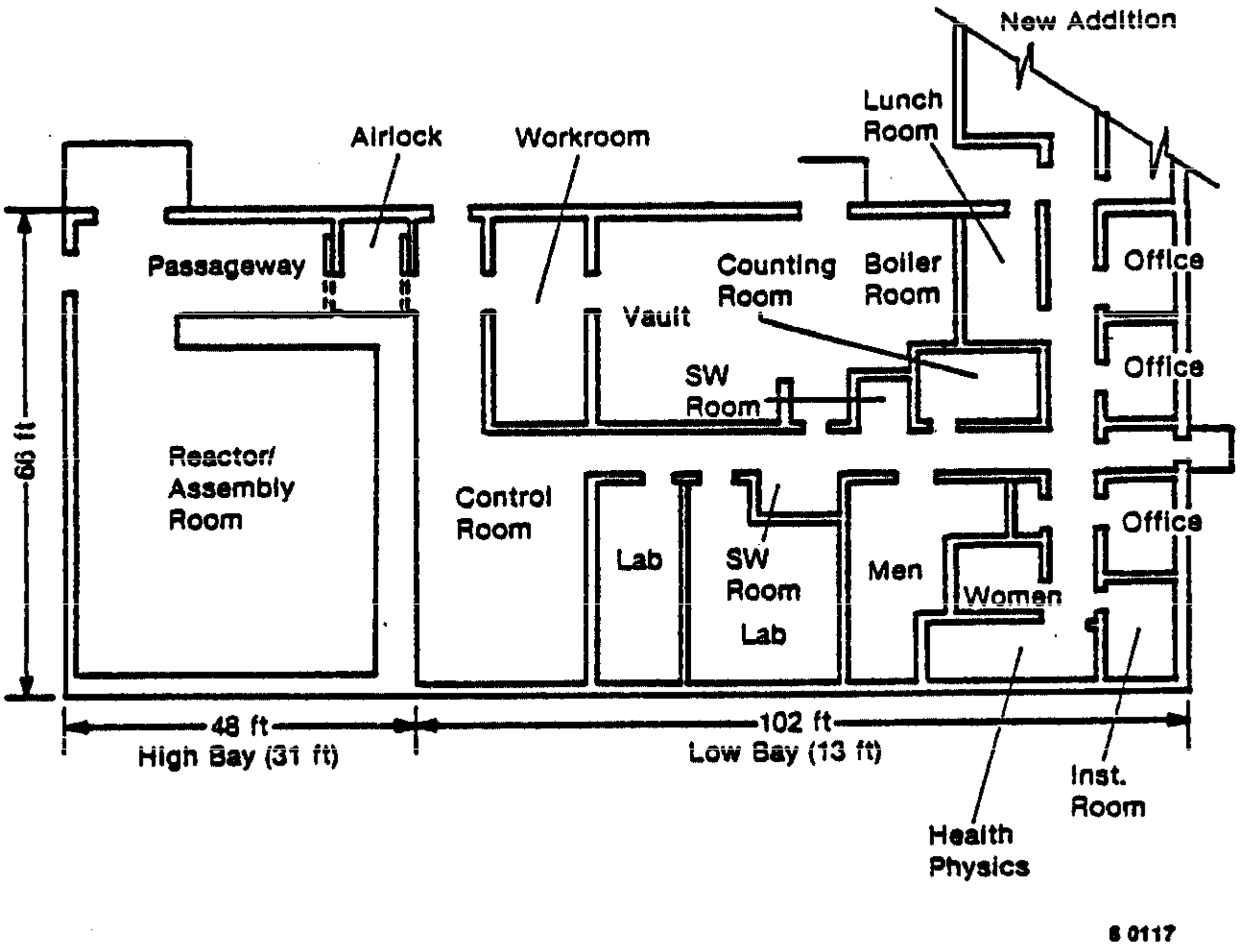


Figure 4.12.1. ZPR-III (Bldg. RTF-60) floor plan.

TABLE 4.12.1. ANNUAL SUMMARY OF RADIOACTIVE LIQUID DISCHARGES FROM THE EBR-I, BORAX, AND ZPR-III SITES

Year	Volume (gallons)	Radioactivity (Curies)
1952	(1)	(1)
1953	0	0
1954	0	0
1955	5000	10
1956	(1)	0.1
1957	1000	0.027
1958	6660	0.104
1959	0	0
1960	0	0
1961	(1)	(1)
1962	(1)	(1)
1963	(1)	(1)
1964	(1)	(1)
1965	(1)	(1)
1966	(1)	(1)
1967	(1)	(1)
1968	(1)	(1)
1969	(1)	(1)

Note: (1) No specific data are available.

TABLE 4.12.2. ANNUAL SUMMARY OF NONRADIOACTIVE LIQUID DISCHARGES FROM THE EBR-I, BORAX, AND ZPR-III SITES

Year	Industrial Waste(1) (gallons x 10^6)	Sanitary Waste(2) (Gallons x 10^3)
1952	(3)	(3)
1953	(3)	(3)
1954	(3)	(3)
1955	(3)	(3)
1956	(3)	(3)
1957	(3)	(3)
1958	(3)	(3)
1959	(3)	(3)
1960	(3)	(3)
1961	(3)	(3)
1962	182	158
1963	253	132
1964	193	106
1965	21.3	79
1966	15.0	79
1967	13.0	52
1968	4.4	52
1969	(3)	(3)

Notes: (1) No chemical consistency for industrial waste is recorded.
(2) No BOD data for sanitary waste are available.
(3) No specific data are available.

TABLE 4.12.3. ANNUAL SUMMARY OF RADIOACTIVE SOLID WASTE FROM THE EBR-I, BORAX, ZPR-III SITES

Year	Volume (Cubic Feet)	Radioactivity (Curies)
1952	(1)	(1)
1953	(1)	(1)
1954	(1)	(1)
1955	(1)	(1)
1956	(1)	(1)
1957	(1)	(1)
1958	16(2)	0.001(2)
1959	1566	1811.0
1960	(3)	(3)
1961	(3)	(3)
1962	(3)	(3)
1963	(3)	(3)
1964	(3)	(3)
1965	(3)	(3)
1966	(3)	(3)
1967	(3)	(3)
1968	(3)	(3)
1969	(3)	(3)

Notes: (1) No specific data are available.
(2) No specific data prior to the month of December, 1958.
(3) All solid waste produced was recorded combined with ANL-W waste.

TABLE 4.12.4. ANNUAL SUMMARY OF NONRADIOACTIVE GAS DISCHARGED FROM THE EBR-I, BORAX AND ZPR-III SITES

Year	Gallons of Fuel Oil	Pounds of Sulfur Discharged
1952-1962	No specific data are available.	--
1963	69,120	7223
1964	62,960	6580
1965	54,760	5722
1966	55,760	5846
1967	66,960	6997
1968	65,880	6884
1969	73,660	7697

4.12.5. ANNUAL SUMMARY OF RADIOACTIVE GAS DISCHARGES THE EBR-I, BORAX, ZPR-III SITES

Curies

Facility	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
BORAX I	1	--															
BORAX II		--	--	--													
BORAX III			--	--													
BORAX IV					--	4565											
BORAX V						--	--	--	--	--	--	7813					
EBR-I			--	--	--	--	--	--	--	--	--						
ZPR-III			0.08	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	5.2

Notes: Facilities that are not in operation are designated with a blank.
Where specific data on discharges are not available, a dash(--) is used.

Though actual measurements were not recorded, conservative estimates have been calculated based on APPR measurements. This resulted in an estimated noble-gas, fission-product release of 0.3 curies/yr resulting from an estimated normal operating power level of 3 watts for an entire year of operation, or a total of 25 kilowatt-hr/yr.

4.13 Liquid Corrosive Chemical Disposal Area (LCCDA)

4.13.1 LCCDA Description

The Liquid Corrosive Chemical Disposal Area (LCCDA) consisted of two surface impoundments used primarily for the disposal of a limited variety of liquid, nonradioactive, corrosive chemicals. It is located on the INEL near the RWMC as shown in Figure 4.13.1. Although officially closed in 1981, the site is still clearly visible and enclosed by a fence.

The LCCDA was probably first used in about 1961. The two surface impoundments were located at either end of a rectangular fenced area, the newer pit at the east end and the older pit on the west end. There is little information on the older pit except that it had been abandoned by 1974. The older pit was probably never more than a depression and was used little in the late 1960s. When use of the site was needed in the early 1970s, the newer pit was constructed. A plot plan of the LCCDA showing the newer pit is provided in Figure 4.13.2. Also, provided in the figure is an end view of this pit which was about 3 m (10 ft) by 4.6 m (15 ft) and 3 m (10 ft) deep. This newer pit had approximately 1.8 m (6 ft) of limestone covering the bottom to facilitate acid neutralization.

The LCCDA was enclosed by a 1.2-m (4-ft) high fence with one gate on the north side. The newer pit was surrounded by a berm about 1 m (3 feet) high and was accessible by both a ground ramp and a cribbed, elevated ramp. the cribbed ramp was used when a dumpster-mounted tank was drained. The ground ramp was used for all other disposals. The older pit probably did not have a set up (berms, ramps, limestone, etc.) as formal as that of the newer pit.

Use of the LCCDA was officially halted in 1981, and there are no records indicating that any waste was received that year. The last recorded incident of waste going to the LCCDA occurred in April 1980. The decision to stop using the site was based at least partially on the fact that its use had been decreasing and did not warrant the cost of upgrading the facility to meet new regulations.

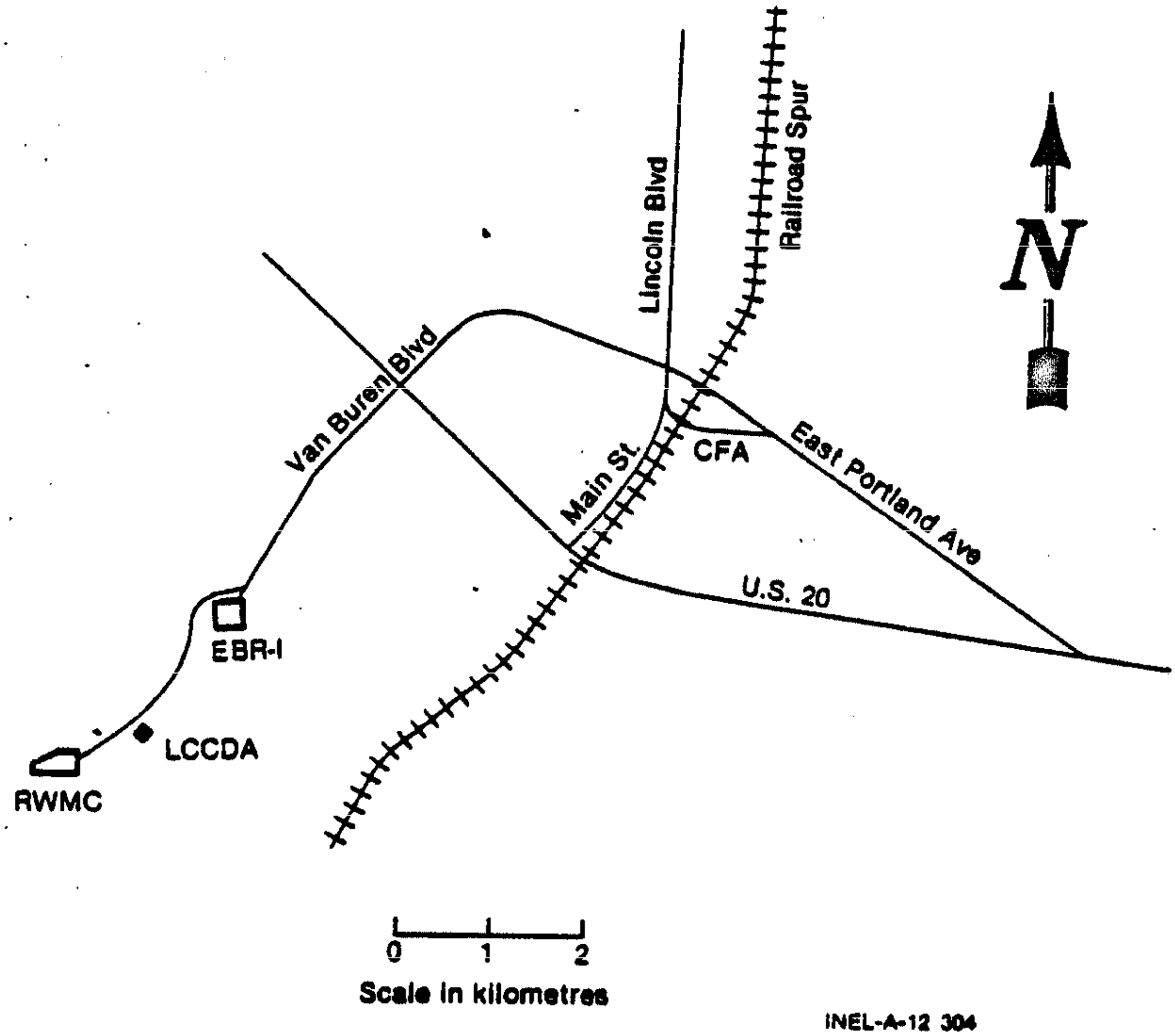


Figure 4.13.1. Vicinity map of LCCDA.

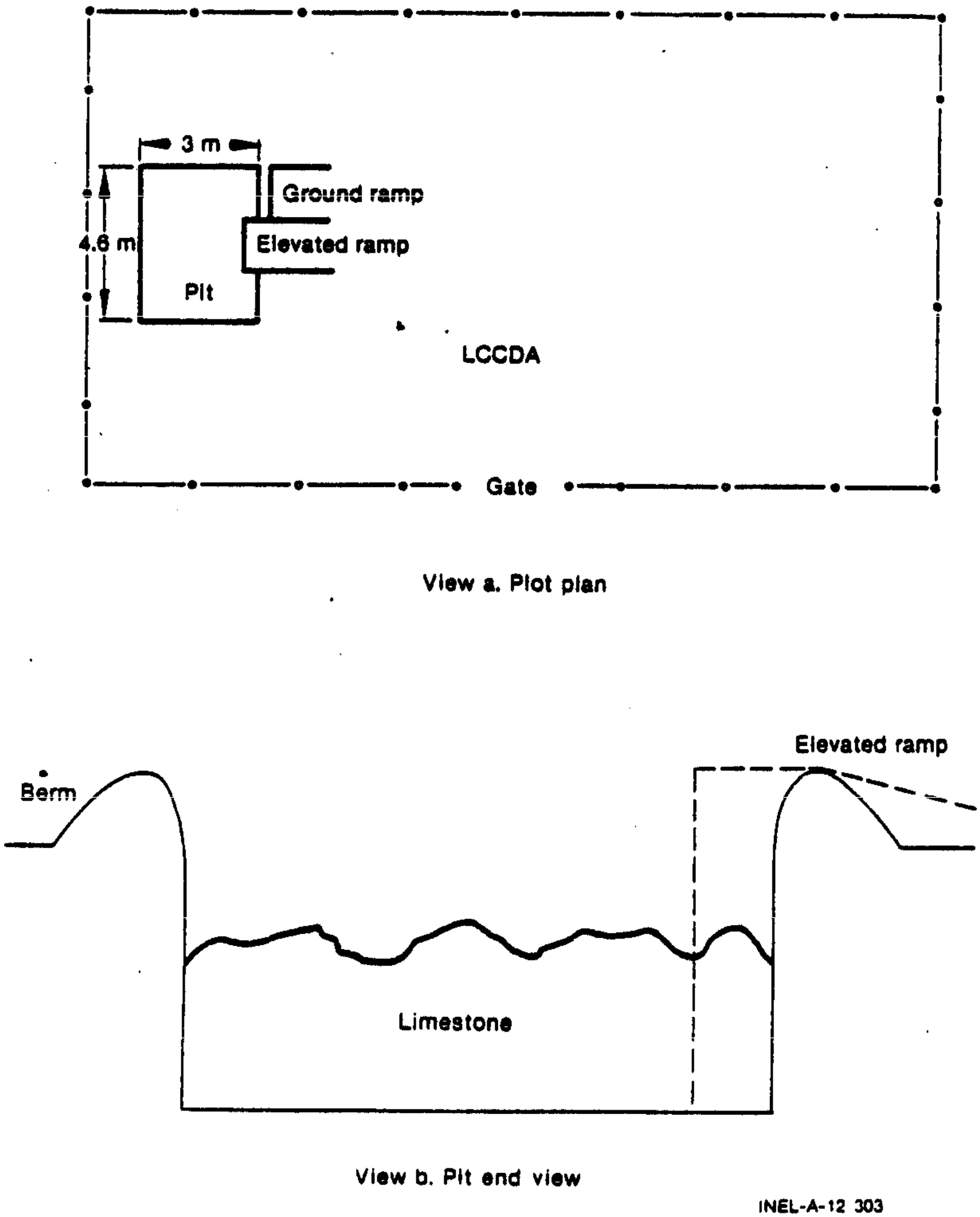


Figure 4.13.2. Plot plan and pit end view of LCCDA.

4.13.2 Wastes Received at the LCCDA

Records indicate that some of the corrosive chemicals taken to the LCCDA were in solid form. The items most often handled were common acidic and basic mineral-based chemicals. Organic-based acids (except acetic acid) and other materials that might present a significant toxicity or hazard potential were normally handled on a case-by-case basis.

Records of wastes going to the LCCDA were not maintained before 1972. Since then, records have been kept as part of the Industrial Waste Management Information System (IWMIS). The IWMIS records correspond with the approximate date that the newer pit within LCCDA was opened; therefore, it is assumed that the recorded information pertains to the newer pit only. For site evaluation purposes, it is estimated that similar volumes of corrosive materials went to the old pit prior to 1972. Table 4.13.1 provides a summary of the materials identified in the IWMIS as going to the LCCDA. It should be noted that the IWMIS has entries for the CFA acid pit, RWMC acid pit, and the CCD Area. From the timeframe involved, it is quite certain that these disposal designations all refer to the site herein identified as the LCCDA.

TABLE 4.13.1. LCCDA HAZARDOUS WASTE DISPOSAL

Site	Site Name	Period of Operation	Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Wastes	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
LCCDA	New pit	1972-1980	13.8	Corrosive materials (S) = Solid, (L) = Liquid		Corrosive materials were dumped in a limestone buttomed pit.	Inactive-pit still remains, but behind locked gate	Snake River Plain Aquifer is about 177 m (580 ft) below the surface which is relatively level. Subsurface consists of alternating layers of basalt and silt	Pit is surrounded by a berm that prevents surface water intrusion	
				Potassium hydroxide (S)	569 gm					
				Sodium hydroxide (S)	786 gm					
				Sodium hydroxide (L)	17,158 L					
				Sodium bicarbonate (S)	136 gm					
				Sodium carbonate (S)	2,041 gm					
				Ammonium hydroxide (L)	1,666 L					
				Sulfuric acid (L)	8,873 L					
				Sulfuric acid sludge (L)	227 L					
				Nitric acid (L)	45 L					
				Phosphoric acid (L)	8 L					
				Hydrochloric acid (L)	95 L					
				Acid tank rinse water (L)	757 L					
				Nitric acid, sodium hydroxide (L)	95 L					
				Hydrobromic acid	5 L					
				Zinc bromide	15 L					
LCCDA	Old pit	1961-1970	10	Assume same materials and quantities as above		Corrosive materials were dumped into an unlined, informal pit	Inactive-pit remnants inside a locked fence	Same	There are no formal structures or grading around pit that would prevent surface water intrustion	

4.14 Munitions/Ordnance Areas

As described in Section 2.1, the U.S. Navy and the U.S. Army Air Corps have in the past used portions of what is now the INEL for gunnery and bombing ranges. As a result, there are numerous sites within the INEL where unexploded ordnance and munitions have been found. This section attempts to document these sites and the potentially hazardous materials which may be present. In cases where DOE-generated hazardous materials may also be present, discussions of such materials are included. (Only those sites involving DOE-generated hazardous materials are considered during the ranking process addressed later in this document.) The general sites of concern are located on the INEL map shown in Figure 4.14.1. The following paragraphs provide discussions on the sites and are presented in the order in which they are identified in Figure 4.14.1. The discussions also refer to aerial photographs of the individual sites which are provided in Appendix C.

4.14.1 Naval Proving Grounds Aerial Bombing Range

4.14.1.1 General Location. The location, as shown in Figure 4.14.1, is northwest of the RWMC. The extent of this bombing range is believed to be several miles in diameter. Figures C.1, C.2, and C.3 in Appendix C are aerial photographs of this site.

4.14.1.2 Description of Past Activities. This area was allegedly a bombing range for B24 Liberator bombing aircraft flying out of the Army Air Force base at Pocatello during WWII. Evidence of these activities includes verbal statements by knowledgeable personnel, explosive ordnance finds of practice bombs with spotting charges, and concentric rings spotted from high altitudes. The practice bombs found to date have been disposed of.

4.14.2 Firing Site for Naval Guns

4.14.2.1 General Location. The firing site is east of the RWMC and north of the Big Southern Butte. Figure C.4 in Appendix C is an aerial photo of this site.

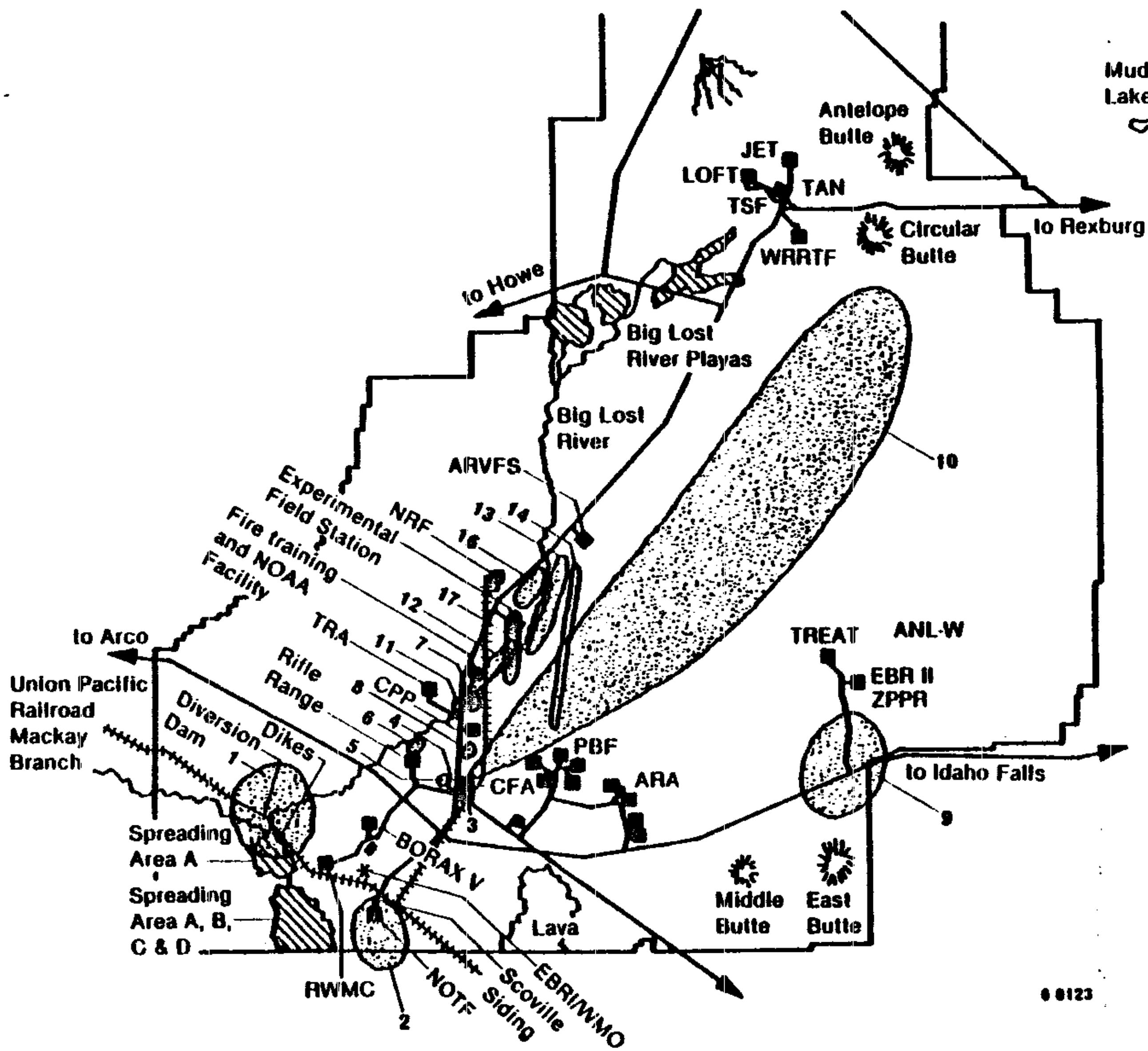


Figure 4.14.1. Map showing munitions/ordnance areas at the INEL.

4.14.2.2 Description of Past Activities. This was the firing site for 16- and possibly 8-inch naval guns. The objects in Figure C.4 are 16-ton reusable concrete blocks that constituted a firing berm. From the information available, this site was used during the Vietnam War to test guns from the Battleship New Jersey which were refurbished at the Naval Ordnance Plant in Pocatello. Downrange azimuths for this firing range were toward the Big Southern Butte. To date there are large numbers of 16-inch shells distributed over the land, most of which are suspected to be mono-block shot rounds. These do not contain main explosive charges, but may contain spotting charges. It should be noted that one 14-inch naval artillery shell has also been found downrange and the New Jersey did not fire 14-inch shells.

4.14.3 CF-633 Naval Firing Site

4.14.3.1 General Location. The location is within the northern portion of the existing Central Facilities Area (CFA), next to the Scoville Power Station. Figures C.5 and C.6 in Appendix C are aerial photos of this site.

4.14.3.2 Description of Past Activities. The CF 633 area was a firing site for naval guns during WWII. Shells were fired at both close and far ranges. Close-range firings were made into 16-ton concrete blocks that were transported by the 200-ton gantry crane which is visible in Figure C.5. Long-range firings were made toward the northeast for distances of up to twenty-nine miles. To date many shells have been found in the CF 633 area and disposed of. Pieces of torpedoes and large quantities of smokeless powder (50-100 pounds) have also been found in the area. A 5-inch artillery shell is known to have been buried 50 feet deep in a French drain located between CF 633 and Scoville station.

4.14.4 Central Facilities Gravel Pit

4.14.4.1 General Location. The gravel pit is just north of the Scoville Power Station at CFA. Figure C.7 in Appendix C is an aerial photo of this site.

4.14.4.2 Description of Plant Activities. A 5-inch naval artillery shell was buried in this gravel pit. The area is now danger signed. The area in front (foreground) of the gravel pit, shown in Figure C.7, was downrange of the CF 633 firing site. During the period when the Navy was using this area, it had extensive lighting and underground cables. Ordnance has also been found in this area.

4.14.5 Central Facilities Sanitary Landfill Area

4.14.5.1 General Location. The sanitary landfill is north-northwest of Central Facilities. Figures C.8 and C.9 in Appendix C are aerial photographs of the site.

4.14.5.2 Description of Past Activities. Explosive ordnance (primarily 5-inch artillery shells) has been found in this area. The points of origin appear to be the Naval Ordnance Disposal Area.

4.14.6 Naval Ordnance Disposal Area (NODA)

4.14.6.1 General Location. The NODA is north-northwest of CFA and nine-tenths of a mile north of the APS small arms/automatic weapons firing range. Figures C.10 and C.11 in Appendix C are aerial photos of the site; Figure C.11 includes the currently used APS firing range.

4.14.6.2 Description of Past Activities. This site was used by the Navy as a disposal and experimental site. Large concentrations of many kinds of ordnance have been found and disposed of. It is known that ordnance is buried under crater ejecta.

More recently, until 1982, the NODA was used as a storage area for hazardous wastes generated at the INEL. The site was then referred to as the Hazardous Materials Depot Area. It was used to store all types of hazardous wastes generated at the INEL: solvents, corrosives, ignitibles, heavy-metal contaminated solutions, formaldehyde, PCB materials, waste laboratory chemicals, reactives, and others. As of October 1985, all these materials had been removed for off-site disposal as hazardous waste or treated on site by open burning as defined by RCRA regulations. In the future the site will be used only for the open burning of reactive/explosive materials, and these materials will be taken there only when they can be burned immediately (i.e., no storage).

In August 1983 four soil samples were taken in the NODA. Analyses were performed by an independent laboratory for priority pollutants, metals, boron, chloride, cyanide, nitrate nitrogen, sulfate, and phenol. Results from the four samples show evidence of toluene and methylene chloride. Several of the inorganics were shown to be present at levels in excess of drinking water standards (used as a frame of reference), but they have not been compared to background levels. Also, EP toxicity tests, as defined under RCRA regulations, have not been performed on the soils.

4.14.7 Explosives Storage Bunkers North of ICPP

4.14.7.1 General Location. The bunkers are one-fourth to one mile north of the Idaho Chemical Processing Plant (ICPP). Figure C.12 in Appendix C is an aerial photo of the site.

4.14.7.2 Description of Past Activities. There are at least two explosive storage magazines, which were demolished in Navy tests, in this general location. Five-inch shells and anti-tank mines have been found and disposed of.

4.14.8 National Oceanic and Atmospheric Administration (NOAA) Grid

4.14.8.1 General Location. The NOAA grid is east of the Test Reactor Area (TRA). Figure C.13 in Appendix C is an aerial photo of the site.

4.14.8.2 Description of Past Activities. The NOAA grid is used for atmospheric testing by releasing chemical agents from the center (note the 200-foot tower used for these releases) and monitoring their transport off site. There are numerous bomb or artillery craters on the grid, from which have been extracted a considerable number of 5-inch artillery shells and chunks of high explosive, mainly TNT.

4.14.9 Aerial Bombing Range Near ANL-W

4.14.9.1 General Location. The center of the range is near the junction of Highway 20 and the access road to Argonne National Laboratory-West (ANL-W). Figures C.14 and C.15 in Appendix C are aerial photos of the area.

4.14.9.2 Description of Past Activities. This area was also a bombing range for Army Air Corps bombers flying practice missions out of Pocatello, Idaho during the 1940's. At the time this range was active there were no ANL-W roads or Highway 20. Practice bombs with spotting charges have been found in the zone, which is greater than a mile in diameter.

4.14.10 CF 633 Area and Downrange Zones

4.14.10.1 General Location. The zone begins at CF 633 with CFA and extends approximately 30 miles downrange to the northeast. Figures C.16 and C.17 in Appendix C are aerial photos of the area.

4.14.10.2 Description of Past Activities. When the Navy was using the area, the Scoville substation and the four white buildings in the lower right quadrant of Figure C.16 did not exist. The CF 633 building and the structures in the foreground constituted a firing station for large-caliber naval guns testing the internal and external ballistics of weapons refurbished at the Naval munitions plant in Pocatello. The range extended to the northeast for approximately 30 miles. Many of the roads seen in the photographs were originally naval roads. The structures to the left of CF 633 were rail foundations to support the 200-ton gantry crane while moving and storing 15-45-ton concrete blocks that were positioned northeast of CF 633 as targets. Fuses, chunks of explosive, parts of torpedoes, smokeless powder and many artillery shells have been cleaned out of this zone. There is one known 5-inch artillery shell that was inadvertently buried in a deep French drain west of CF 633. Downrange are remnants of naval structures and shells that have been fired from this zone. The shells found to date are primarily of the 5- and 14-inch varieties.

4.14.11 Fire Station II Zone, West of Lincoln Boulevard

4.14.11.1 General Location. The location is across the road from Fire Station II. Figure C.18 in Appendix C is an aerial photo of the area looking toward TRA.

4.14.11.2 Description of Past Activities. This area west of Lincoln Blvd. is infested with remnants of explosive tests involving anti-tank mines. It is not certain whether this area was a point of explosive origin or whether the materials were launched from some other area. Most of the debris is harmless, but live anti-tank mine fuses have been found, as has one anti-tank mine.

4.14.12 Range-Fire Burn Area, East-Northeast of Fire Station II

4.14.12.1 General Location. This area is adjacent to Fire Station II and extends in an east-northeasterly direction in excess of one mile. Figure C.19 in Appendix C is an aerial photo of the area.

4.14.12.2 Description of Past Activities. In the early 1970s, a range fire was accidently started during fire training exercises at Fire Station II. The fire burned approximately 800 acres and "cooked-off" (thermally initiated) a large number of pieces of explosive ordnance. This fire was a key occurrence in emphasizing the problem of unexploded ordnance within the INEL.

4.14.13 Zone East of the Big Lost River

4.14.13.1 General Location. As shown in Figure 4.14.1, this site is an area just east of the Big Lost River, which extends from north of the ICPP to the Naval Reactor Facility (NRF). Figures C.20, C.21 and C.22 in Appendix C are aerial photos of this area.

4.14.13.2 Description of Past Activities. Many single pieces of explosive ordnance have been found in this large area. To date no large concentrations have been found, but some surveyors claim to have seen large assortments of ordnance; searches conducted with these people did not result in finds. Much of the ordnance found were 3- and 5-inch artillery shells, primarily mono-block shot rounds.

4.14.14 Anaconda Power Line

4.14.14.1 General Location. These power lines run generally north and south several miles east of Lincoln Boulevard. Figure C.23 in Appendix C is an aerial photo of the area.

4.14.14.2 Description of Past Activities. This section of power line has been the site of a number of explosive ordnance finds. Probably 25 pieces of ordnance have been found to date, mostly 5-inch artillery shells, of mono-block shot round design. Most shells have been fired through gun tubes, as evidenced by lands and groove marks on the gas check band. Two 5-inch shells which had not been fired have been found. Both had mechanical time fuses which were subsequently destroyed.

4.14.15 Old Military Structures or Remnants

4.14.15.1 General Location. This area is not shown on Figure 4.14.1, but it consists of numerous old facilities located between CFA and the bomb craters east of NRF. Figures C.24 and C.25 in Appendix C are aerial photos that show examples of these facilities.

4.14.15.2 Description of Past Activities. There are several demolished structures, or the remnants thereof, that were originally built to serve as protective areas in which witnesses to explosives testing could stand. In this capacity, they were to stand within the shock flowfield and respond to the pressure and impulse that resulted from the large explosives tests being conducted. Figure C.25 shows a concrete structure that housed high-speed cameras used in documenting some of the tests. Ordnance has been found at some of these sites.

4.14.16 Large-Scale Naval Magazine Test Area

4.14.16.1 General Location. This test area is east of NRF and adjacent to the Big Lost River. Figures C.26 through C.31 in Appendix C are aerial photos of the site.

4.14.16.2 Description of Past Activities. This is an area where the Navy conducted large explosive magazine sympathetic detonation tests. Some of the detonations involved three explosive magazines, each with 500,000 pounds of explosive ordnance. There have been many kinds of ordnance found, most of which have been partially exploded: 500- and 1000-lb bombs and fuses, anti-tank mines and fuses, and artillery shells of various calibers. There are many burned-out containers for smokeless powder. This site is the point of origin for ordnance that traveled four miles.

4.14.17 Dairy Farm Revetments

4.14.17.1 General Location. The revetments are southeast of NRF, northeast of ICPP, and bounded on the east by the Big Lost River. Figures C.32 through C.35 in Appendix C are aerial photographs of this site.

4.14.17.2 Description of Past Activities. Many concrete revetment walls, approximately 1 ft thick by 10 feet high by 12 feet long are in this area. There are bomb craters near some walls, while others are free of any evidence of explosive loading. It is most likely these revetments served as protectors of sensitive munitions tested during the large detonation tests. Ordnance has been found near some of the adjacent craters.

4.15 CFA Past Activity

4.15.1 CFA Description

The Central Facilities Area (CFA) is located in the south-central portion of the INEL, as was shown in Figure 3.3. The facilities now in use at CFA were, for the most part, built in the 1940's and 1950's. These facilities were initially used to house Naval Gunnery Range personnel and, later, National Reactor Testing Station personnel. These facilities have been modified over the past 30 years to fit the changing needs of the Idaho National Engineering Laboratory (INEL). They now provide four major types of functional space: craft, office, services, and laboratory.

The purpose of CFA is to ensure efficient, centralized support for programmatic and nonprogrammatic efforts of all INEL contractors and DOE. Accomplishing this mission involves the efforts of several government offices as well as contractors. The scope of this report includes only those CFA facilities operated by EG&G Idaho, Inc.

Because CFA covers a large area and includes some 80 buildings and structures, it is divided into eight sections for planning purposes. These sections, shown in Figure 4.15.1, are described as follows:

4.15.1.1 The Handling and Open Storage Section. This section is located between the service shops and East Portland Avenue. It contains a large stockpile of processed manganese ore.

4.15.1.2 The Remote Service Facilities Section. This section is located on the northeast end of CFA and includes light laboratories, the Scoville Power substation and control house, the sewage treatment plant, laundry, and the fuel storage area.

4.15.1.3 The Administrative Offices and Support Section. This section is bounded by Main Street on the east, Ogden Avenue on the north,

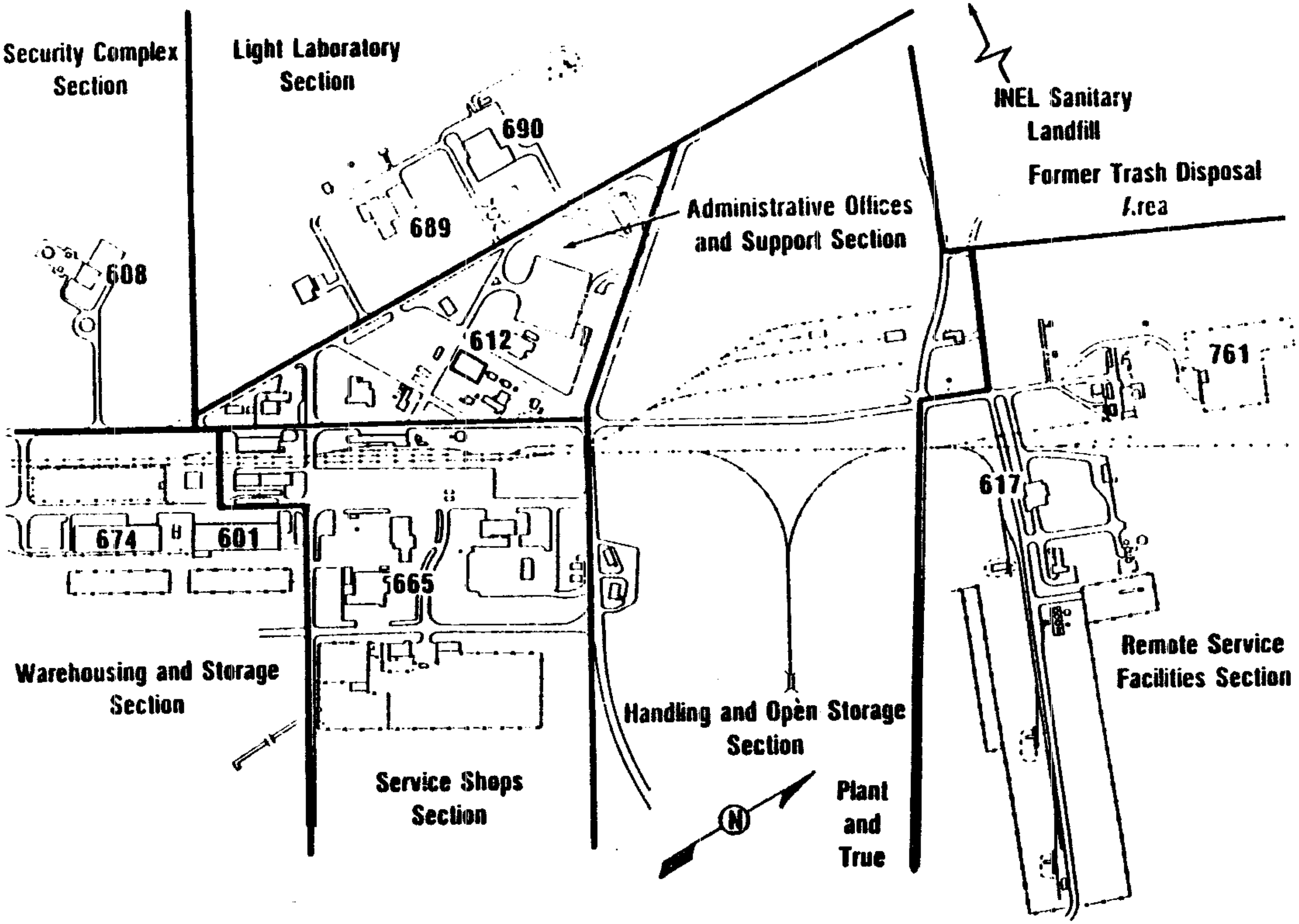


Figure 4.15.1. Central Facilities Area (CFA) Layout Map

and Lincoln Boulevard on the west. Within this triangle are the central security headquarters, medical dispensary, communications center, bus depot, cafeteria, craft shops, and other offices.

4.15.1.4 The Service Shops Section. This section, located east of the Administration Office and Support Section, is the site of vehicle maintenance shops, main INEL fire station, Morrison-Knudsen office building, bus dispatch, motor pool, and multicraft shop complex.

4.15.1.5 The Light Laboratory Section. This section is located on the west side of Lincoln Boulevard. It includes two large laboratory buildings, the Technical Center, and the Radiological Environmental Sciences Laboratory (RESL); the latter is operated by the Department of Energy.

4.15.1.6 The INEL Sanitary Landfill. The landfill is now located 1/4 mile west of the Lincoln Boulevard and West Portland Avenue intersection. The area, formerly used for trash disposal (shown in Figure 4.15.1), has been reclaimed for future use pending Department of Energy, Idaho Operations (DOE-ID) evaluation of the Site.

4.15.1.7 The Warehousing and Storage Section. This section, located in the southeast portion of CFA, contains two large warehouses used for storage and material receiving.

4.15.1.8 The Security Complex Section. This section is located on the extreme west side of CFA and currently contains the Helicopter Storage and Maintenance Facility.

4.15.2 CFA Waste Generated by Activity

Waste generations are addressed in the following paragraphs according to the buildings and operations involved. A summation of the hazardous waste generation is found in Table 4.15.1. It should be noted that two areas of possible concern at CFA are not included in this report because

TABLE 4.15.1. CFA HAZARDOUS WASTE GENERATION

Location	Function	Waste Stream	Time-Frame	Estimated Quantities (If Known)	Treatment/Storage/Disposal
CF-617/669	Central Laundry Facility	Lightly radioactive contaminated wastewater	1950-Present	See Section 4.15.3	CFA Sewage Treatment Plant
CF-633	Laboratory Facility	Laboratory wastewater with small quantities of corrosives, radionuclides and possibly solvents	1950-1984	Unknown	CF-633 French Drain
CF-654	Paint Shop	Waste paint and paint thinners	1950-1983	190 L/yr	CFA Landfill
			1984-Present	190 L/yr	Off-site as Hazardous Waste
CF-664	Service Station	Oils and grease from steam cleaning of equipment	1951-1983	Unknown	Motor Pool Pond
			1983-Present	Unknown	CFA Sewage Treatment Plant after oil and sand trap
CF-665	Equipment Repair Building	Waste petroleum products	1951-Present	Unknown	Waste oil tank
		Trichloroethane vapor degreaser bottoms	1970-1984	10 drums/yr	CFA Landfill
		Battery acid (sulfuric)	1951-1982	1700 L/yr	Motor Pool Pond
		Waste paints and thinners from paint and body work	1951-1985	500 L/yr	CFA Landfill
CF-674	Fuel Processing Prototype Experiments	Extraction/Dissolution Materials - Corrosives - Mercury - Natural uranium	1954-1956	2,500 L/yr	CF-674 Pond
		Calciner Wastes - Mercury - Natural uranium	1956-1965	Unknown	CF-674 Pond

they are not controlled by EG&G Idaho, Inc. The two sites are the Radiological and Environmental Sciences Laboratory (RESL) and the DOE Fire Department Training Facility.

4.15.2.1 CF-617/669. The Central Laundry Facility has been located at CF-617 since 1981. Prior to that time the laundry operation was in CF-669. Both facilities are at the north end of CFA, as shown in Figure 4.15.2. The "hot" laundry section of the facility involves the acceptance, washing, and drying of radioactively contaminated clothing and items which can be laundered. The laundry uses normal detergents which are not considered hazardous. However, as a result of the operation, the wastewater leaving the facility is lightly contaminated with radioactivity. Wastewater from the facility flows to the CFA Sewage Treatment Plant. Influent to the treatment plant is sampled weekly for radioactivity, and the results are reported in the Radioactive Waste Management Information System (RWMIS).

4.15.2.2 CF 633. Through the years, the CF 633 building has housed laboratory facilities. In 1985, EG&G set up a lab operation there; from 1976 through 1984 WINCO operated an environmental analysis group laboratory in this building; and prior to that the RESL (then called the Health Services Laboratory) was located there. Other than the sanitary sewer, the wastewater (including laboratory sink waste) from this building flows to a French drain located just outside the east end of the building. EG&G's recent operations have included packaging and off-site disposal of hazardous waste whenever possible. WINCO's operation routinely generated small quantities of acids and bases that were washed down sinks along with small quantities of radionuclides. The RESL operation probably included similar materials and may have included small quantities of solvents such as xylene or toluene in scintillation cocktails. The maximum allowable discharge of radionuclides from WINCO operations (1976 to 1984) was 10 nanoCuries per day. Using this as a conservative estimate of the actual discharge to the French drain, as much as 2.3×10^{-5} curies were sent to this drain. (This assumes 260 operating days per year over a nine-year period). For scoring purposes, this figure will be doubled to include the RESL activities and will be assumed to be beta activity.

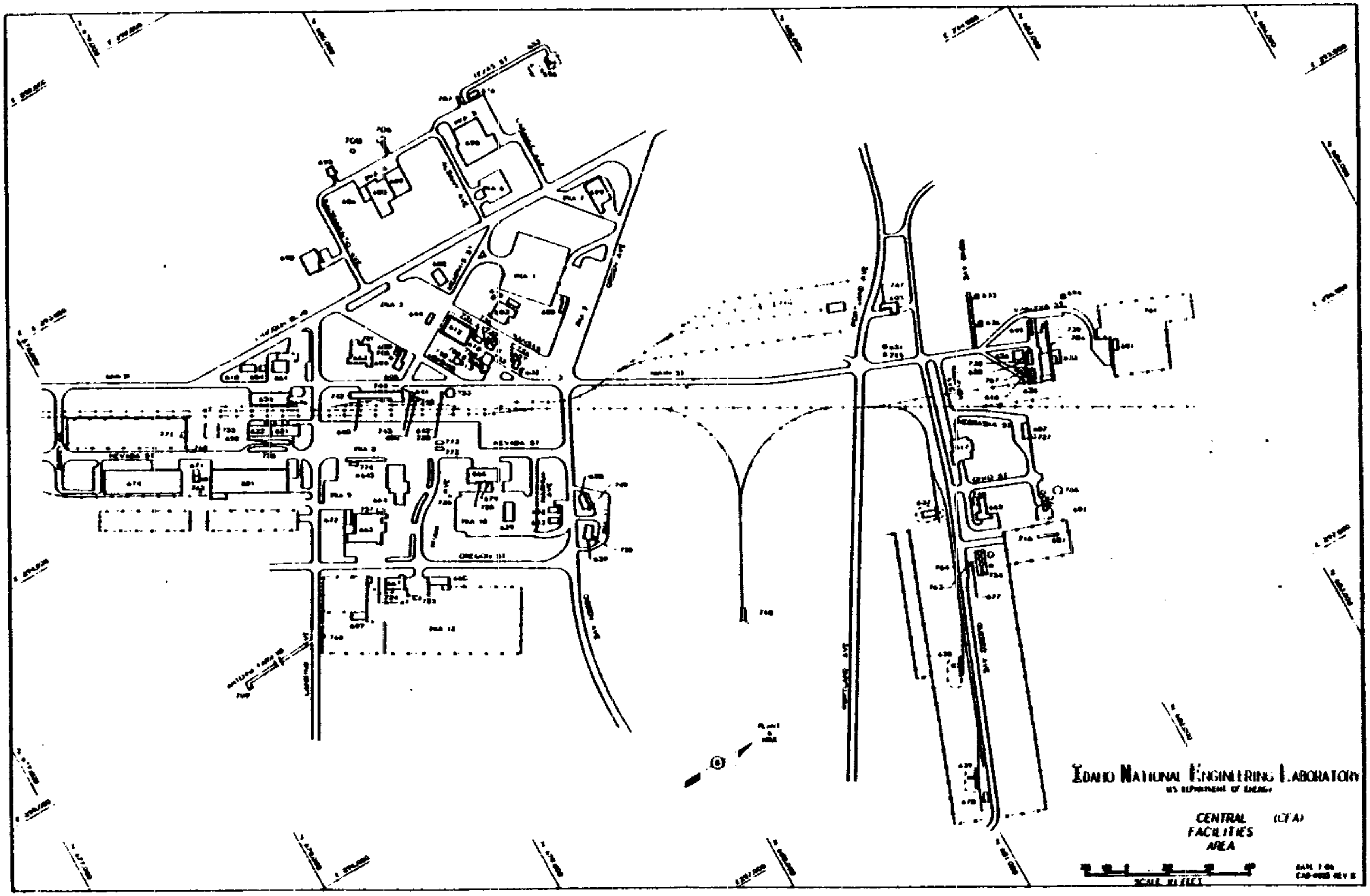


Figure 4.15.2. Central Facilities Area Plot Plan.

4.15.2.3 CF-654. The Maintenance Shop facility at CF-654 includes a paint shop that routinely produces hazardous wastes. These wastes consist primarily of flammable thinners but occasionally include paint and paint residues. Various types of thinners are used at the shop and may find their way to the waste; paints used include acrylics, epoxies, enamels and latex. It is estimated that 95 to 190 L (25 to 50 gallons) of waste thinners are generated yearly at this shop. For the past two years the waste has been turned in for disposal as hazardous waste. Prior to that, it was thrown out as garbage and was probably buried or burned at the CFA landfill. It is also likely that paint is occasionally dumped at the various work sites when small quantities of materials are left over. These small individual sites are not addressed further as they are not specifically identified and should not pose a significant threat of migration.

4.15.2.4 CF-664. The service station facility at CF-664 houses a steam cleaning operation. Prior to about mid-1983, the water from this operation, along with the grease and grime it generated, was discharged to the Motor Pool Pond. The amount of oils and grease discharged is unknown, but two or three pieces of equipment are cleaned every day. Past cleaning operations have, at times, included washing radioactively contaminated equipment. When this occurred the wash area was roped off and the ground (asphalt-covered) was monitored after the operation to check for any remaining activity. The wash area was kept clean, but it is known that some minor amounts of radioactivity were discharged to the catch basin and thence to the Motor Pool Pond. In about mid-1983, discharge from the steam cleaning operation was rerouted to a grease trap and sand trap. Effluent from these traps then went to the CFA Sewage Treatment Plant.

4.15.2.5 CF-665. The Equipment Repair Building at CF-665 was constructed in 1951 and houses the repair facilities for the INEL bus and passenger car fleet. Other motorized equipment is also repaired there. Individual activities within the building which produce wastes of concern are addressed below.

Waste oil generated at the facility is put in an "oil dump" receptacle, the contents of which are pumped to an underground tank outside the building. Various fluids (i.e., lubricating oil, transmission fluid, brake fluid, Stoddard Solvent, etc.) have been disposed of in this manner. The waste oil tanks are currently pumped by an oil recycling contractor, but past operations very likely included spreading on dirt roads for dust suppression and burning by the Fire Department as part of fire training exercises.

For the last 10 to 15 years the facility has operated a trichloroethane vapor degreaser. For the purposes of this report, it is assumed that it has been used since 1970. Bottoms in the degreaser are cleaned out and drumed about once every three months. It is estimated that 10 drums of waste are generated each year in this manner. Prior to mid-1984 this waste was sent to the CFA landfill; since that time it has received disposal off site as hazardous waste.

The facility changes up to 300 batteries per year. Prior to about 1982, the acid from the old batteries (1 to 2 gallons from each battery) was dumped down the drain in the battery room which led to the Motor Pool Pond. Under present operations, the batteries are taken wet (i.e., acid included) by a recycling contractor. Any batteries that cannot be handled by this contractor are sent to salvage where they are handled on a case-by-case basis.

Painting and body work are routinely done in this facility. Empty paint cans are regularly thrown in the trash, but waste paint and thinner are also generated. It is estimated that two liters of waste acrylic enamel paint and acrylic thinner mixtures are generated each work day. Until this year, these wastes were put into gallon cans and thrown in the trash that goes to the CFA landfill.

Asbestos-lined brake shoes generated at the facility are also buried at the CFA landfill.

4.15.2.6 CF-674. This building is currently a warehouse, but in the past it housed proto-type or pilot-plant experiments for the fuel-processing operations that are now done at the ICPP. The processes that were tested at CF-674 from about 1953/54 to about 1965 included the following:

- Dissolution of simulated fuel elements. This tested processes to dissolve primarily aluminum cladding.

- Extraction of uranium from dissolution mixture. Dissolution mixtures were spiked with natural uranium to test the capability of extraction columns to recover uranium.

- Concentration of uranium recovered during extraction process. The aqueous solutions from the extraction columns were run through an evaporator to further concentrate the uranium. The concentrated uranium solution was normally reused to spike the feed solutions for the other extraction process tests.

- Calciner for converting liquid radioactive waste to solid form. Solutions of varying chemical compositions were formulated and processed through a small calciner to determine the effectiveness of the operation as related to the composition of the feed stock.

There are no records on the types or quantities of hazardous wastes that were generated from the fuel processing pilot plant operations. However, personnel that worked on the operations are aware of the types of chemicals that were used and it can be assumed that these chemicals reached the waste stream. The chemicals that could be found in the dissolving and extracting process included:

Aluminum
Nitric acid
Mercuric nitrate
Zirconium fluoride
Hydrofluoric acid
Natural uranium

The chemicals associated with the calcining operation included:

- Aluminum
- Zirconium
- Aluminum nitrate
- Aluminum oxide
- Mercury
- Sodium
- Sodium nitrate
- Boric acid
- Natural uranium

Through discussions with personnel involved with the pilot plant operations, it is estimated that the extraction/dissolution processes may have generated about 2,500 L (660 gal) per year. The plant was operational from 1954 through 1956.

Waste from the calciner operation was limited to the calcine itself and wastewater generated from the venturi scrubber on the calciner's off-gas system. The scrubber water likely included small amounts of the chemicals identified previously as being associated with the calciner.

Liquid wastes generated during the pilot-plant operations were probably drained to the small pond-like depression southeast of the building. It is possible that the calcine material may have been dumped there also.

4.15.2.7 CFA Fuels/Petroleum Management. Bulk fuels and oils used or stored at CFA included unleaded gasoline, diesel fuel, No. 2 fuel oil and waste oil. All tanks are supplied by tank truck. There are no records of any significant fuel spills occurring in CFA. Table 4.15.2 provides an inventory of the fuel/petroleum storage tanks at CFA. The locations are shown by facility number in Figure 4.15.2.

TABLE 4.15.2. CFA FUEL/PETROLEUM STORAGE TANKS

Location or Tank Number Location	Oil Type	Maximum Capacity (g)	Above (A), Underground (U), Outside (O), Inside (I)	Level Check	IMMS Number	Responsibility	Comments
CFA	Unleaded gasoline	7	A, O	7	--	M-K	West of M-K building
CFA	Diesel	7	A, O	7	--	M-K	West of M-K building
CFA-604	No. 2 fuel oil	300	U, I	Automatic refill	--	Plant services	--
CFA-605	No. 2 fuel oil	1,000	U, O	Automatic refill	--	Plant services	--
CFA-607	No. 2 fuel oil	500	U, O	Automatic refill	--	Plant services	--
CFA-608	No. 2 fuel oil	500	U, O	Automatic refill	--	Plant services	--
CFA-609	No. 2 fuel oil	500	U, O	Automatic refill	--	Plant services	--
CFA-610	No. 2 fuel oil	500	U, O	Automatic refill	--	Plant services	--
CFA-613	No. 2 fuel oil	500	U, O	Automatic refill	--	Plant services	--
CFA-614	No. 2 fuel oil	500	U, O	--	--	--	Abandoned
CFA-615	No. 2 fuel oil	500	U, O	--	--	--	Abandoned
CFA-633	No. 2 fuel oil	5,000	U, O	Automatic refill	--	Plant services	2 tanks
CFA-641	No. 2 fuel oil	--	U, O	--	--	--	Abandoned
CFA-645	Diesel blend	10,000	U, O	Dipstick	01SSW211 01SSW212	Transportation	2 tanks
CFA-658	No. 2 fuel oil	1,000	U, O	Automatic refill	--	Plant services	--
CFA-659	No. 2 fuel oil	1,000	U, O	Automatic refill	--	Plant services	--
CFA-662	No. 2 fuel oil	5,000	U, O	Automatic refill	--	Plant services	--
CFA-664	Unleaded gasoline	10,000	U, O	Dipstick	01SSW203	Transportation	--
CFA-664	Unleaded gasoline	8,000	U, O	Dipstick	01SSW204	Transportation	--
CFA-665	No. 2 fuel oil	12,000	U, O	Dipstick	01TMP252	Transportation	--
CFA-665	Waste oil	5,000	U, O	Dipstick	--	Transportation	--

TABLE 4.15.2. (continued)

Location or Tank Number Location	Oil Type	Maximum Capacity (g)	Above (A), Underground (U), Outside (O), Inside (I)	Level Check	IMMS Number	Responsibility	Comments
CFA-665	Waste oil	2,000	U, O	Dipstick	--	Transportation	--
CFA-667	No. 2 fuel oil	6,000	U, O	Automatic refill	--	Plant services	--
CFA-668	No. 2 fuel oil	1,000	U, O	Automatic refill	--	Plant services	--
CFA-669	No. 2 fuel oil	18,000	U, O	--	--	Plant services	Abandoned
CFA-671	No. 2 fuel oil	17,000	U, O	Dipstick	01TMP250	Plant services	--
CFA-675	Diesel No. 2	500	U, O	Automatic refill	--	Plant services	--
CFA-680	Gasoline	7	U, O	--	--	Plant services	Abandoned
CFA-682	Diesel storage tank	~500	U, O	Automatic refill	--	Plant services	Next to RR
CFA-683	No. 2 fuel oil	1,000	U, O	Automatic refill	--	Plant services	--
CFA-687	No. 2 fuel oil	1,000	U, O	Automatic refill	--	Plant services	--
CFA-699	Unleaded gasoline	500	U, O	Dipstick	01SSW200	Plant services	--
CFA-708	No. 2 fuel oil	42,420	A, I	Gauge on outside of tank	01TMP251	Plant services	--
CFA-755	Diesel blend	60,060	U, O	Dipstick	01BFW214	Site services	Abandoned
CFA-755	Diesel blend	11,200	U, O	Dipstick	01BFW213	Site services	Abandoned
CFA-754	No. 2 fuel oil	29,988	U, O	Gauge on outside of tank	01BFW249	Site services	--
CFA-754	Diesel blend	20,580	U, O	Gauge on outside of tank	01BFW215	Site services	--
CFA-754	Unleaded gasoline	20,580	U, O	Gauge on outside of tank	01BFW205	Site services	--
CFA-754	Diesel No. 1	5,040	U, O	Gauge on outside of tank	01BFW245	Site services	--
CFA-754	Diesel No. 1	5,040	U, O	Gauge on outside of tank	01BFW246	Site services	--
CFA-754	Unleaded gasoline	15,750	U, O	Gauge on outside of tank	01BFW206	Site services	--
CFA=754	Diesel blend	46,200	A, O	Gauge on outside of tank	01BFW216	Site services	--

TABLE 4.15.2. (continued)

Location or Tank Number Location	Oil Type	Maximum Capacity (g)	Above (A), Underground (U), Outside (O), Inside (I)	Level Check	IMMS Number	Responsibility	Comments
CFA-764	Waste oil	7	U, O	Dipstick	--	Site services	--
Fire Station No. 2	No. 2 fuel oil	1,000	U, O	Automatic refill	--	Plant services	--

4.15.3 CFA Disposal Sites

Areas or sites at CFA at which hazardous and/or radioactive wastes may have been deposited are discussed in the following paragraphs. A summary of the hazardous waste findings is presented in Table 4.15.3.

4.15.3.1 CFA Sewage Treatment Plant and Filter Field (CF-691).

4.15.3.1.1 Description--The CFA Sewage Treatment Plant consists basically of a primary clarifier, a trickling filter and a secondary clarifier. Solids from the primary clarifier are sent to a sludge digester; solids from the secondary clarifier are recycled to the primary clarifier. Treated effluent is discharged to a filter field. The Plant also has a septic tank system for overflow. A schematic for the plant operation is shown in Figure 4.15.3.

4.15.3.1.2 Wastes Received--The sewage treatment plant was designed to handle the sanitary sewage generated at CFA. However, it also receives lightly radioactively contaminated washwater from the Central Laundry Facility at CF-617. The radioactivity sent to the plant is recorded in the RWMIS and is summarized in Table 4.15.4. Some of the contamination undoubtedly drops out in the treatment sludge, but for rating purposes, it is assumed that the activity listed in Table 4.15.4 has passed through the plant and gone to the filter field.

Concern that radioactivity may show up in the sludge has made it a practice to send the dried material to the RWMC for disposal. In about 1980 the line from the laundry (CF-617) was diverted and sent to the septic tank system as shown in Figure 4.15.3. This was done, at least partially, in an attempt to eliminate the radioactivity from the sludge generated in the main treatment plant.

TABLE 4.15.3. CFA HAZARDOUS WASTE DISPOSAL SITES

Site	Site Name	Period of Operation	Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Wastes	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
CF-691	CFA Sewage Treatment Plant/Filter Field	1953-Present	NA	Radioactive contaminated wash water	See Table 4.15.4	Treated wastewater is discharged to a subsurface drainage or filter field	Active	Snake River Plain Aquifer is about 148 m (485 feet) below the surface which is generally level. Subsurface consists of alternating layers of basalt and silt	Surface run-on is not excluded from the drainage field area	
	Motor Pool Pond	1951-1983	5,000	Oils and grease Battery acid (sulfuric) Dioctylphthalate	Unknown 56,100 L Unknown	Discharge lines from Equipment Repair Building (CF-665) discharged directly to the pond	Inactive--waste lines rerouted through grease and sand traps to the CFA Sewage Treatment Plant	Same	Surface run-on is not excluded from the excavated pond area	
	Old CFA Sanitary Landfill	1951-1981	150,000	Miscellaneous/Unknown hazardous materials[a]	30 M^3	Cut and fill landfill operation-no liners or impermeable covers	Inactive	Same	Surface run-on is not excluded from the excavated pond area	
				Asbestos[a]	590 M^3					
				Chrome/chromates[a]	205 M^3					
				Mercury[a]	1 g					
				Methyl Dithiocyrate[a]	23 g					
				Beryllium[a]	1 g					
				Zirconium chips[a]	1 M^3					
				Trichloroethane sludge bottoms	120 drums					
				Waste paint and thinners	24,000 L					
				Assumed total hazardous materials reaching landfill	Total 100-150 drums/yr					

TABLE 4.15.3. (continued)

Site	Site Name	Period of Operation	Size (m^2)	Suspected Types of Wastes	Estimated Quantity of Wastes	Method of Operation	Closure Status	Geological Setting	Surface Drainage	Evident and Potential Problems
CF-633	French drain or seepage pit.	1950-Present	NA	Lab wastewater with small quantities of corrosives, radionuclides and possible solvents.	Unknown	Lab sinks drain to this French drain.	Inactive--since 1984 no hazardous wastes discharged.	Same	Discharge area is subsurface, but there has been no action taken to preclude surface infiltration.	
CF-674	CF-674 Pond	1954-1965	3,000	Chemical and natural uranium contaminated wastewater from fuel processing prototype operations. Mercury is also suspect.	Unknown	Floor drains led to this pond.	Inactive	Same	Pond depression area is open to surface drainage.	

a. From IWMIS Reports.

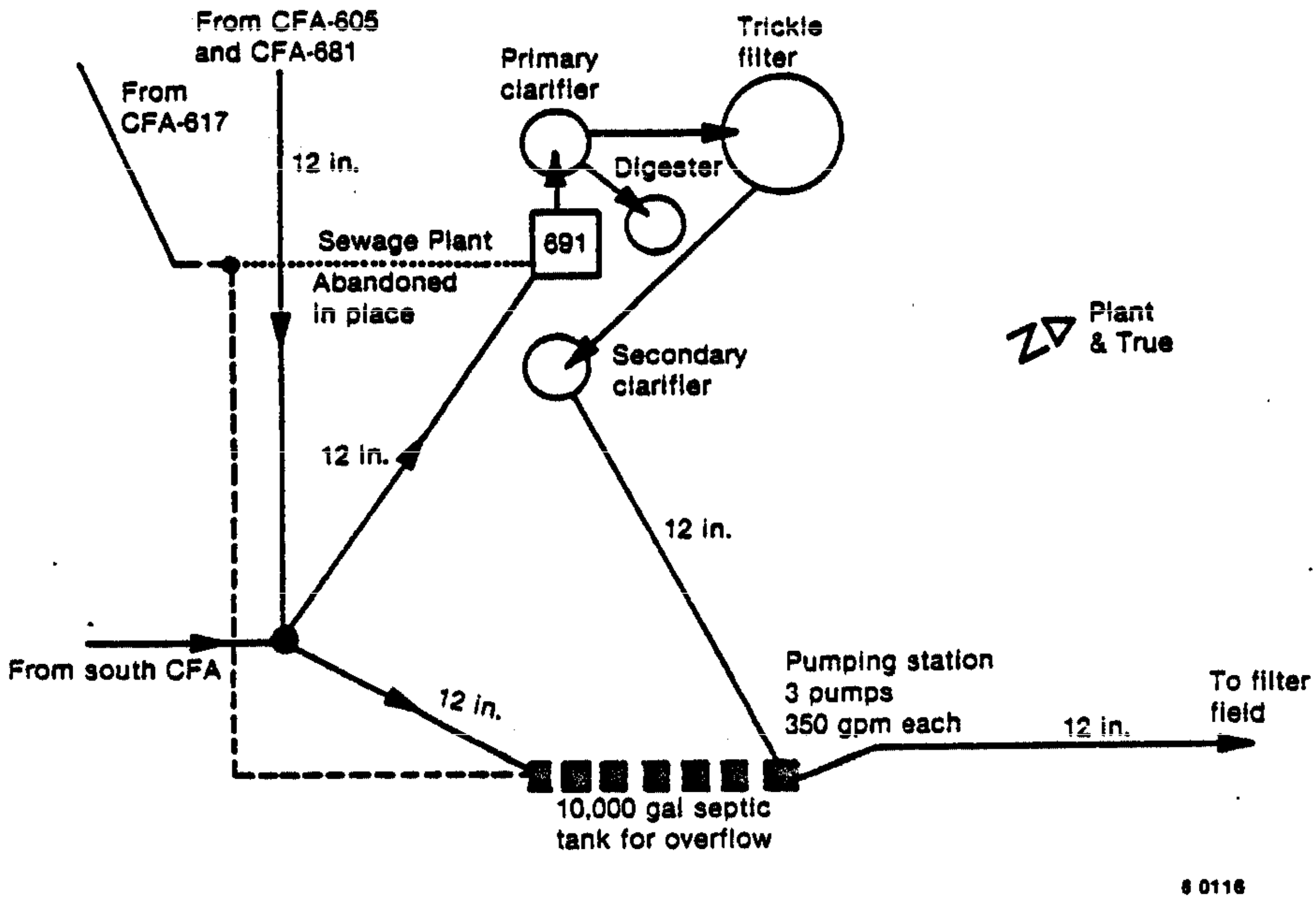


Figure 4.15.3. Schematic of CFA Sewage Treatment Plant.

TABLE 4.15.4. CURIES RELEASED TO CFA SEWAGE TREATMENT PLANT FILTER FIELD (BY NUCLIDE) (1961-SEPTEMBER 1985)

Nuclide	Curies Released
Barium-140	5.24×10^{-5}
Cerium-141	5.79×10^{-4}
Cerium-144	2.88×10^{-2}
Cobalt-58	2.91×10^{-2}
Cobalt-60	5.74×10^{-2}
Chromium-51	1.20×10^{-2}
Cesium-134	4.82×10^{-3}
Cesium-137	8.82×10^{-2}
Europium-152	4.41×10^{-5}
Tritium (H-3)	2.69×10^{1}
Hafnium-181	2.56×10^{-2}
Iodine-131	1.96×10^{-3}
Manganese-54	4.77×10^{-4}
Niobium-95	5.80×10^{-3}
Ruthenium-103	8.73×10^{-5}
Ruthenium-106	2.94×10^{-2}
Antimony-125	1.25×10^{-4}
Strontium-89	1.94×10^{-2}
Strontium-90	2.94×10^{-1}
Unidentified Alpha	2.57×10^{-2}
Unidentified Beta and Gamma	1.29×10^{0}
Yttrium-90	1.30×10^{-2}
Zirconium-95	9.32×10^{4}
Total Curies	2.88×10^{1}

4.15.3.2 Motor Pool Pond.

4.15.3.2.1 Description--The Motor Pool Pond is an excavated pond area located east of parking area 12 in Figure 4.15.2. Historically, it has taken waste from the Equipment Repair Building (CF-665) and the Service Station (CF-664). In mid-1983, flow to the pond was diverted to the CFA Sewage Treatment Plant after passing through grease and sand traps.

4.15.3.2.2 Wastes Received--The wastewater discharged to the Motor Pool Pond contained oils, greases, and battery acids. The quantities of waste received are shown in Table 4.15.3. Water and sediment samples were taken from the pond in 1982. A summary of the results from this sampling is provided in Table 4.15.5. Several constituents of concern were identified in the pond sediment, but these were generally below action levels. Of particular interest are the quantities of bis (2-ethylhexyl) phthalate or dioctyl phthalate (DOP) found in the sediment. It is unknown how the DOP got to the pond but it is suspected that it may have been used in some of the motor pool solvent cleaning tanks, the contents of which may have found their way to the pond.

At times the Motor Pool Pond also received washwater from the wash-down of radioactively contaminated equipment. There have been instances in which contaminated vehicles/equipment were cleaned at the steam cleaning facility at CF-664 which drains to the pond. Past radiological surveys of the pond have at times indicated contamination, but more recent surveys have shown nothing of concern.

4.15.3.3 CFA Landfill.

4.15.3.3.1 Description--As mentioned in Section 4.15.1.6, the sanitary landfill at CFA is designated the INEL landfill, and historically was located first on the west then the east of Lincoln Boulevard, but was recently moved back to the west side. The landfill is a cut and fill operation; that is, trenches are dug and waste is deposited. The trenches

TABLE 4.15.5. WATER AND SEDIMENT ANALYSIS FOR CFA MOTOR POOL POND SEPTEMBER 1982

Element	Water (mg/L, ppb)	Sediment (mg/g, ppm)
Aluminum	BDL[a]	192.0
Chromium	BDL	8.2
Barium	BDL	72.5
Cadmium	BDL	1.2
Cobalt	BDL	2.0
Copper	BDL	21.7
Iron	875	3416.7
Lead	BDL	7.5
Nickel	BDL	8.3
Manganese	115	70.0
Zinc	BDL	83.3
Boron	450	37.5
Ions	(mg/L, ppm)	
Chlorides	330	NA[b]
Nitrate-N	0.2	NA
Sulfate	30	NA
Organics	(mg/L, ppb)	(mg/kg, ppb)
bis (2-ethylhexyl) phthalate	6	4000
PCB-1016	BDL	170

a. BDL--below detection limit.

b. NA--not analyzed.

are then backfilled to cover the waste and new trenches are dug as necessary. Solid waste is brought from all over the site to this location. The aerial photograph in Figure 4.15.4 shows the approximate location of the CFA landfill.

4.15.3.3.2 Wastes Received--The sanitary landfill has always had tight controls on receiving radioactive materials, but up until about 1980 there was probably little concern over other potentially hazardous materials being sent there. To some extent, records have been kept of materials going to the landfill since 1971. However, these records are often nonspecific and do not include all the hazardous chemicals or materials that went to the landfill, particularly those that went in small quantities combined with other solid wastes. Table 4.15.3 provides a list of known or recorded hazardous materials that have been buried at the landfill. It includes items identified in records (Industrial Waste Management Information System--IWMIS) and the trichloroethane vapor degreaser bottoms and the paint/paint thinner residues described in Section 4.15.2. Materials shown in the IWMIS date back only to 1971; it can be assumed that similar materials were buried from 1951 to 1971. Reviewing the types and quantities of wastes now generated within the INEL, certain assumptions can be made on which waste streams may have gone to the landfill in the past. These waste streams currently amount to about 100 drums per year. It is further assumed that similar or larger waste streams existed in the past since there have at times been larger numbers of operations going on at the site than there are at present. For ranking purposes the figure of 100 to 150 drums per year will be used.

4.15.3.4 CF-633 French Drain.

4.15.3.4.1 Description--CF-633 was constructed so that drains with the potential to receive contamination (radioactive contamination was of primary concern) were plumbed to a French drain or seepage pit located just outside the east end of the building. A seepage pit is generally an excavated area which is backfilled with a permeable material such as gravel and into which the wastewater is piped.

Figure 4.15.4. Aerial view of CFA landfill vicinity.

4.15.3.4.2 Wastes Received--The CF-633 facility has housed several laboratory facilities as described in Section 4.15.2.2. It is suspected that the wastewater created from these laboratories contained small quantities of corrosives, radionuclides and possibly solvents such as xylene and toluene which are commonly used in scintillation cocktails. There is no record of the quantities of waste that went to the seepage pit, but the hazardous constituents were probably relatively small.

4.15.3.5 CF-674 Pond.

4.15.3.5.1 Description--This abandoned pond is a low area just southeast of CF-674 (see Figure 4.15.2). It is connected by underground pipe to the south end of CF-674. Wastewater is no longer being discharged to the pond, but there have been no attempts to fill in the depression or to grade the area to prevent surface runoff.

4.15.3.5.2 Wastes Received--The only identified wastes of concern entering this pond are those associated with the fuel processing pilot plant operations. There is no record of the wastes that went to this pond, but it is likely that hazardous constituents such as mercury, acids, zirconium, and natural uranium were included. Although quantities are unknown, the processes involved were small, pilot-plant operations that were run only intermittently. For purposes of applying the Hazard Ranking System (HRS), it is assumed that fewer than 500 drums of hazardous constituents went to the CF-674 pond. This should be a conservatively high estimate since most waste associated with the calciner operation was water and estimated quantities of wastes from the other operations are about 12 drums per year.

It should be noted that there was radioactive contamination reported due to a spill adjacent to the CF-674 facility and to the wastewater discharged to the CF-674 Pond. According to people who worked on the pilot plant operations, any radioactivity was due solely to the natural uranium that was used to make up the test solutions. Contaminated soil next to the building was removed and taken to the RWMC at the time of the spill. Past radiological surveys of the pond have shown minor activity but more recent surveys have detected none.

4.16 Radioactive Waste Management Complex (RWMC) Review

4.16.1 RWMC Description

The Radioactive Waste Management Complex (RWMC) was established at the INEL in 1952 to accommodate the radioactive wastes generated by laboratory operations. It is located in the southwest corner of the INEL. In addition to receiving wastes generated by the INEL, the RWMC has received wastes from Rocky Flats since 1954, and smaller quantities from other DOE facilities, including Argonne National Laboratory--East, Bettis Atomic Power Laboratory, Battelle Columbus Laboratory, and Mound Laboratory.

The original area involved 13 acres. This was expanded to over 88 acres in 1957 and enclosed a pit previously used for the disposal of laboratory acid. Currently, the RWMC encompasses approximately 144 acres.

The RWMC may be divided into two major sections. The first is the Subsurface Disposal Area (SDA); the second is the Transuranic Storage Area (TSA). Each of these sections contains several smaller storage areas, as can be seen in Figure 4.16.1.

4.16.1.1 Subsurface Disposal Area. The SDA contains low-level waste which has been segregated based on radioactivity and container size. Wastes go into either a large pit, trenches, or soil vaults and are covered with earth. This is considered permanent disposal.

The Transuranic Disposal Area (TDA) is an asphalt pad within the SDA that is used for permanent disposal of uranic and transuranic wastes containing fewer than ten nanocuries (nCi) of transuranic activity per gram of waste. The waste containers are stacked on the asphalt pad and then covered with earth. These wastes are considered permanently disposed of.

4.16.1.2 Transuranic Storage Area. The TSA consists of asphalt pads adjacent to the SDA. The TSA is used for storage of transuranic wastes containing more than 10 nCi of transuranic activity per gram of waste.

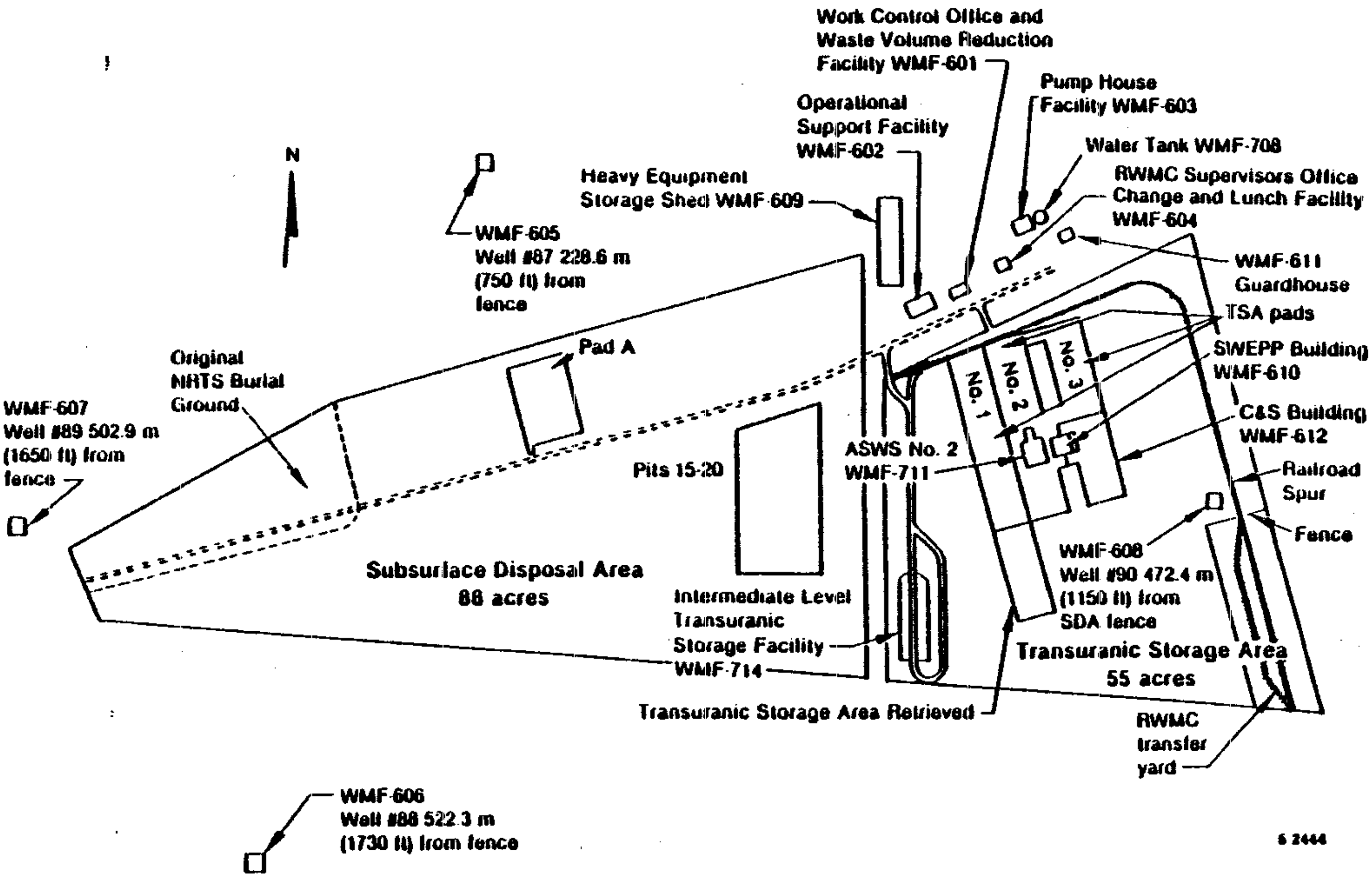


Figure 4.16.1. Radioactive Waste Management Complex.

The TSA is used for interim waste storage in which the waste is stored in containers designed for 20-year integrity. The containers are stacked, covered with plywood and nylon-reinforced polyvinyl, and then a final covering of two to three feet of earth. This waste is retrievable and will be removed to a federal repository when one becomes available.

The RWMC is enclosed by fences and surrounded by dikes and drainage channels.

4.16.2 Sources of Waste Stored at the RWMC

4.16.2.1 Idaho National Engineering Laboratory. The buried waste consists of a variety of radioactively contaminated materials including: Construction and demolition material, laboratory equipment, protective clothing, maintenance equipment, decontamination materials, and waste processing products. Some of this waste may be considered hazardous. The hazardous wastes known to be buried at the RWMC include: Acetone, antimony, benzene, cadmium, hydrofluoric acid, mercury, and thallium. Other buried hazardous materials include asbestos, beryllium, gasoline, lead, nitrates, oil, palladium, polychlorinated biphenyls, and zirconium. Exact types and quantities of contaminated, hazardous materials buried at the RWMC are unknown, but quantities of most are thought to be small.

Review of Unusual Occurrence Reports provided the information in this section. During normal Initial Drum Retrieval (IDR) operations on June 22, 1978, a drum labeled "Cyanamide - Cyanide Poison" was discovered. The drum was repackaged and will be opened at a later date. Another drum, labeled "Fragmentation Bomb," was discovered during the IDR. This drum was opened under controlled conditions and found to contain ordinary waste. It is suspected that the waste generator had reused an empty container without bothering to change or do away with the old label. It is quite likely that the drum labeled "Cyanamide" is from a similar action.

During compaction of CPP Dumpster D-249 on June 21, 1984, a waste liquid was observed. The waste liquid appeared to be a strong acid. CPP identified the liquid as fuming nitric acid. This would indicate that small amounts of acids are present at the RWMC as part of laboratory waste.

Recent records (1980 to present) give more details on the composition of the waste buried at the RWMC. Approximately 37% of the total disposed waste from 1980 on has come from CPP. Of this, lead is the most often mentioned hazardous material. Cadmium is also mentioned frequently, although exact amounts for both are unknown. Other identifiable hazardous wastes present, or believed to be present, at the RWMC are given in Table 4.16.1. These are INEL-generated wastes.

A variety of hazardous wastes from other national laboratories has been disposed of at the RWMC, although the total amount of hazardous waste is thought to be small. Table 4.16.2 gives a general overview of the following information.

4.16.2.2 Rocky Flats Plant. Beryllium (Be) contamination exists in first- and second-stage sludges and in solidified organic wastes. In addition, small amounts of Be are generated by various R&D efforts in plutonium processing areas. The concentration of Be in drums of solidified organic waste is unknown.

Prior to 1973, mercury and lithium batteries were periodically placed in second-stage sludge drums. At this time, second-stage sludge drums were also used periodically to dispose of bottles of liquid chemical wastes and small containers of elemental mercury. The number of batteries and volume or type of chemicals placed in the sludge drums are unknown. First- and second-stage sludge drums also contain a variety of residual toxic heavy elements from processing various plant-generated liquid wastes.

TABLE 4.16.1. IDENTIFIABLE HAZARDOUS WASTES AT THE RWMC*

AREA	MATERIALS	HAZARDOUS RATING
ARA	Pb - Pb shielding	Very-likely-present hazardous material[a]
	Zr - not fine enough to be ignitable	Very-likely-present hazardous material
CFA	Pb - Pb dross from Pb Shop	Identifiable hazardous material[b]
	Pb - Pb pig for shielding source	Very-likely-present hazardous material
CPP	Pb, Cd, Pb - brick form uranium - nonpyrophoric form	Identifiable hazardous material
	Pb, Cd, Hg	Very-likely-present hazardous material
	Zr, acids, - raffinate grab samples "everything" basin cleanup sludge, acids and nitrates in 1983 soil	Known-to-be-present hazardous material[c]
NRF	Asbestos, Pb - Pb shielding	Very-likely-present hazardous material
	Chromate in (nonroutine) resin	Known-to-be-present hazardous material
PBF	Pb -Pb shielding	Very-likely-present hazardous material
TAN	Pb - shielding for "hot" waste in waste package	Very-likely-present hazardous material
TRA	U, UO_2 - uranium scrap	Identifiable hazardous material
	Be - Be reflect pieces	Very-likely-present hazardous material
	Cr, Na - resin	Known-to-be-present hazardous material

a. Very-likely-present hazardous material constituent - depended on the knowledge of the waste based on the description, building of origin, timeframe, and other sources of the person interviewed.

b. Identifiable Hazardous Material - if hazardous material was specifically mentioned, i.e., lead pig or lead bricks.

c. Known-to-be-present hazardous material constituent - same basis as "very likely present" but more of an educated guess or inference.

* Information taken from correspondence written by T. Watanabe and sent to D. L. Uhl from E. A. Jennrich.

TABLE 4.16.2. HAZARDOUS MATERIALS INCLUDED IN STORED TRU WASTES

	Waste Generators					
Hazardous Material	MND	BCL	BAPL	ANL-E	RFP	INEL
Mercury (elemental)	X				X	
Beryllium (compounds)	X			X	X	X
Asbestos		X				X
Nitrated Wastes	X			X	X	
Organic Wastes (mixtures unknown)				X	X	
Polychlorinated Biphenyl (PCB)		0		0	X	
Polyethylene Glycol			X			
Other Chemical Unknown					X	
Gas Generation/Pressurization in Waste Containers	0				X	
Pressurized Vessels					0	
Batteries (lithium, mercury)					X	
Biological Wastes					X	
Pyrophorics					0	

MND = Mound Laboratory
BCL = Battelle Columbus Laboratory
BAPL = Bettis Atomic Power Laboratory
ANL-E = Argonne National Laboratory--East
RFP = Rocky Flats Plant
INEL = Idaho National Engineering Laboratory
X = Hazard identified as existing in stored waste
0 = Hazard identified as potentially existing in stored waste

Large quantities of nitric acid are used in plutonium-recovery operations and smaller quantities are used by many other plutonium operations. Generally, no free nitric acid is present in solid waste packages, as it was absorbed on paperwipes, rags, or other absorbent material.

Ion-exchange resins are used by production plutonium-recovery operations to purify plutonium-bearing solutions. Ion-exchange column resins are usually changed once or twice a year, depending on the rate of production plutonium-recovery operations. During recovery operations, the resins are exposed to various concentrations of nitric acid. Since 1972, resin wastes have been leached with water and then solidified with Portland cement in 1-gallon polyethylene bottles before placement in a waste drum. It is believed cemented resins should not represent a significant hazard. The number of drums containing resin wastes that may represent a hazard is unknown.

Small amounts of unoxidized (metallic) plutonium and/or metastable plutonium suboxides may be present in vacuum pots that were connected to plutonium machining stations. The pots were included with other wastes generated by D&D operations conducted in 1969. Another potential source of pyrophorics includes any depleted uranium wastes retrieved and placed in storage during INEL retrieval projects.

Transuranic contaminated oils containing polychlorinated biphenyls were periodically processed with other organic wastes until 1979 at RFP. The concentration of PCBs in these oils is believed to be >500 ppm, although records concerning processing of PCB oils are not complete. The total number of PCB-contaminated drums is unknown.

Large quantities of asbestos or materials containing asbestos (filters, insulation, fire blankets, gloves, etc.), have been included in waste shipments to the INEL. Specifics concerning asbestos content or volume are unknown.

Pressurized gases have been used at RFP for calibration of laboratory and monitoring instrumentation and for use in production areas. A large number of contaminated gas cylinders, including CO_2 fire extinguishers, were included in waste shipments to the INEL, after a fire in 1969. It was believed most of the gas cylinders were depressurized prior to placement in waste containers. Certain gases may have been hazardous to depressurize in the work environment and would have been placed directly into waste containers. Information concerning the type of gases, cylinder sizes, shipment dates, and related data was not available.

During 1979 and 1980, 70 RFP-generated waste drums were retrieved from storage at the INEL and returned to RFP for characterization. Results of the characterization project revealed that four drums had elevated levels of hydrogen (6, 12, 13, and 19% by volume). The lower explosive limit for hydrogen in air is 4.1% by volume. Hydrogen generation may occur from alpha-radiolysis of water and organic or cellulosic materials.

Pressurization of waste drums may occur from gases (hydrogen, oxygen, etc.) produced by radiolytic, bacterial, and chemical actions. During 1980, a first-stage sludge drum, placed in storage at the INEL during 1978, was discovered to be pressurized. Analysis of the drum indicated the pressure to be 19.6 psig. Other stored waste drums, particularly first-stage sludge drums, may also be pressurized.

4.16.2.3 Argonne National Laboratory--East. Argonne National Laboratory--East, Argonne, Illinois, has been shipping wastes to the INEL since 1974. Some of these shipments have included small amounts of beryllium, the volume of which is unknown. Organic wastes such as scintillation liquids, alcohols (low-carbon aliphatic, generally butyl), and various oils, have been included in waste shipments. The wastes were absorbed on vermiculite contained in metal cans and polyethylene bottles. Some of the wastes were the result of D&D operations. The number or volume of cans or bottles containing absorbed scintillation liquids, absorbed alcohols, or oil included in waste shipments is unknown. It is also unknown if any of the oils contained PCBs.

Organic-based resins are generated by isotope separation and recovery experiments. The resins are exposed to various concentrations of nitric acid and are usually rinsed with either oxalic acid or a mixture of HCl/HF acids before disposal. Oxalic acid denitrates the resin and removes most of the fissile material. Resins rinsed with HCl/HF may be in the nitrate form. The overall volume of ion-exchange resins generated by ANL-E operations is believed to be small. Specific information is not available.

4.16.2.4 Bettis Atomic Power Laboratory. Bettis Atomic Power Laboratory, West Mifflin, Pennsylvania, began shipping wastes to the INEL in 1983. Polyethylene glycol (carbo wax), in the form of solid powder or flakes, was packaged in metal cans and then placed in waste drums. The volume of material included in waste shipments is unknown.

4.16.2.5 Battelle Columbus Laboratories. PCBs may be present in waste oils removed from various equipment pieces (lathes, presses, etc.) during D&D operations. The oils were absorbed with Oil-Dri (trade name) and are contained in approximately 20 1-gallon metal cans.

4.16.2.6 The Mound Laboratory. The Mound Laboratory, Miamisburg, Ohio, has sent approximately 61 cartons of contaminated elemental mercury to the RWMC. The total estimated quantity of mercury included in the waste is 7.63 gallons (864 lb).

Several 1-gallon cartons of beryllium-contaminated wastes are generated on a yearly basis by analytical operations at the Mound Laboratory. The beryllium in these cartons is estimated to be >0.05 grams each.

An estimated 20 drums of absorbed acidic wastes were shipped from Mound to the INEL. These drums may be pressurized due to a chemical reaction between the calcium carbonate contained in the absorbent agent and the acidic waste. Radiolytic production of hydrogen gas may also occur in certain waste drums from here. Suspect drums would be in-line-generated combustible wastes and >100 nCi/g combustible waste drums.

Spent ion-exchange resins, from recovery operations, have been included in waste shipments. The resins were exposed to various concentrations of nitric acid during recovery operations. Although believed to be washed with water, it is not known how completely the resins were denitrated. Numerous cartons of asbestos filters and some asbestos gloves have also been included in waste shipments.

4.16.3 Evidence of Radionuclide Migration

4.16.3.1 Surface Waters. Surface-water runoff was collected at the RWMC for radionuclide analysis following periods of rainfall or snowmelt. Results are shown in Table 4.16.3. Generally, only naturally occurring radionuclides were detected in SDA pump samples. On March 14, Cs-137, Pu-239, -240, Sr-90; and Am-241 were detected in the sample collected at the SDA pump. The detection concentrations probably reflect the increase in particulate concentrations during this time. The higher-than-normal values for plutonium and americium on March 22 are the result of an unusual occurrence and are not representative of RWMC surface waters.

Preliminary modeling of environmental transport of radionuclides at the RWMC indicates that the water pumped from the SDA may be a chief transport pathway of radionuclides from the SDA. However, it is relatively inconsequential in terms of dose. Radionuclides in the discharged water become adsorbed or attached to soil particles and can accumulate. Although the pumped runoff water may be one of the largest radionuclide transport pathways at the RWMC, the pathway is not connected with any potable water source and therefore does not represent a hazard to personnel or to the off-site population.

Surface waters are monitored for nitrates to determine the potential migration of waste containing soluble nitrates.

Water samples were collected at the lowest point in the Pad A drainage system. Results of nitrate analysis are shown in Figure 4.16.2.

TABLE 4.16.3. WATER SAMPLE RESULTS FROM SPECIFIC RADIONUCLIDE ANALYSIS

		Concentrations (10^{-8} mCi/mL)[a,b,c]			
Date of Collection	Sampling Location	Radionuclide	Detected in Filtrate Only	Detected in Particulate Only	Weight of Particulates (mg)
03/14/84	SDA Pump	Cs-137	1.62 ± 0.17[b]	4.50 ± 0.34	7200
		Pu-239-240	0.016 ± 0.006	Not analyzed[d]	7200
		Am-241	0.80 ± 0.020	Not analyzed	7200
		Sr-90	2.20 ± 0.20	Not analyzed	7200
	Pad A, TSA 1, TSA 2, Control	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	NA[e]
03/19/84	SDA Pump, Control, Replicates	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	NA
03/22/84	Pit 10[f]	Pu-238	4.30 ± 0.10	Not analyzed	840
		Pu-239-240	122 ± 3.00	Not analyzed	840
		Am-241	88.6 ± 7.2	65.8 ± 3.20	840
		Sr-90	0.15 ± 0.07	Not analyzed	
03/22/84	SDA Pump, Replicates	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	NA
03/28/84	SDA Pump, Control	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	NA
06/19/84	Pad A, TSA 1, TSA 2, Control	Cs-137	0.37 ± 0.085	Not analyzed	1920
		Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	NA
07/25/84	Pad A, TSA 1, Control	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	NA
08/02/84	SDA Pump	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	NA
10/25/84	TSA 2	Pu-239, -240	0.013 ± 0.004	Not analyzed	480
		Am-241	0.001 ± 0.0005	Not anlayzed	480

TABLE 4.16.3. (continued)

Date of Collection	Sampling Location	Radionuclide	Concentrations $(10^{-8}$ mCi/mL$)^{a,b,c}$ Detected in Filtrate Only	Detected in Particulate Only	Weight of Particulates (mg)
10/25/84	Pad A	Am-241	0.014 ± 0.005	Not analyzed	1280
10/25/84	Control	Pu-239, 240	0.009 ± 0.004	Not analyzed	1040
		Am-241	0.06 ± 0.02	Not analyzed	1040
		Total U	0.02 ± 0.01	Not analyzed	1040
10/25/84	TSA 1, TSA 3	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	Only naturally occurring radionuclides detected	NA

a. Naturally occurring radionuclides (Ra-226, Th-232, Po-214, Bi-214, and K-40) were detected in all samples, but are not reported here.

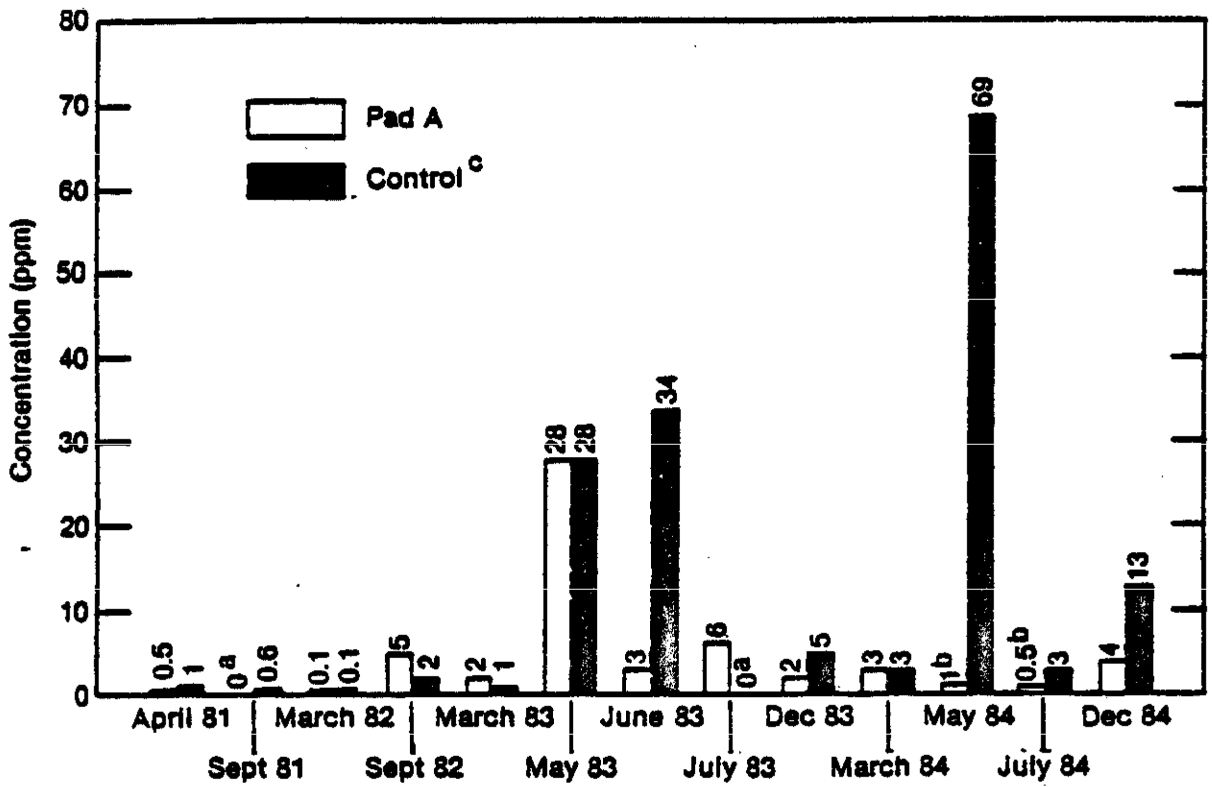
b. Because the water samples are acidified prior to filtration, radionuclides originally ion-exchanged or physically sorbed onto suspended solids may have been solubilized to some degree. Thus, the radionuclide concentrations in the liquid may be higher than that which existed in the environment. Likewise, the radionuclide concentrations in the particulate portion may be lower than in the environment.

c. Results presented as positive in this table are ≥ 2 analytical uncertainties; analytical uncertainties are presented at ± 1 s.

d. The particulates were not analyzed by radiochemistry in 1984, but will be in 1985.

e. NA = Not applicable.

f. Values obtained for these samples are the result of a spill within the RWMC and are not representative of normal conditions.



a. No water available
b. Below detection limit
c. In 1981 and 1982, the control was taken from the Big Lost River. In 1983 and 1984, the control was taken 3 miles northeast of the RWMC

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Figure 4.16.2. Nitrate concentrations in water samples from Pad A.

The results are variable and no trends of increasing or decreasing concentrations are apparent. For several reasons it cannot be inferred from these data that no leaching of nitrates from Pad A has occurred. The control location may not be representative of Pad A conditions because Pad A is covered with lakebed soils, which may contain more nitrates. It is also difficult to interpret the inconsistent fluctuations in the data. Finally, the water samples were not collected from an optimal location. Dilution of water occurred because it mixed with surface runoff from the asphalt pad adjoining Pad A.

4.16.3.2 Subsurface Water. The United States Geological Survey (USGS) routinely samples subsurface water from monitoring wells located in and adjacent to the RWMC. These well locations are shown in Figure 4.16.3. Traces of tritium were discovered in several wells during one such sampling (See Table 4.16.4). The source of the tritium is from past disposal of wastewater at the ICPP and TRA operations. No gamma-emitting radionuclides or plutonium were observed in any of the wells. A very small quantity of Am-241 was observed in one well. The last time Am-241 was observed was in July of 1982.

Results of chemical analyses performed on samples of subsurface water collected by the USGS in 1984 are shown in Tables 4.16.4 and 4.16.5. Except for wells 88 and 92, specific conductance (an indicator of total mineral content) measurements appear to be consistent with past results. Several factors may have contributed to the rise in conductivity in well 88. Briefly these include, but are not limited to, the following. The aquifer may be receiving highly mineralized water from the perched-water table. Minerals could be leaching from the previously unleached cement well casing as a result of the current rising subsurface water levels. The increase may represent normal hydrological conditions. Finally, material from the RWMC may have become mobilized by past flooding and transported through the unsaturated zone.

Based on the available data, conclusions cannot be made regarding the cause of the fluctuations.

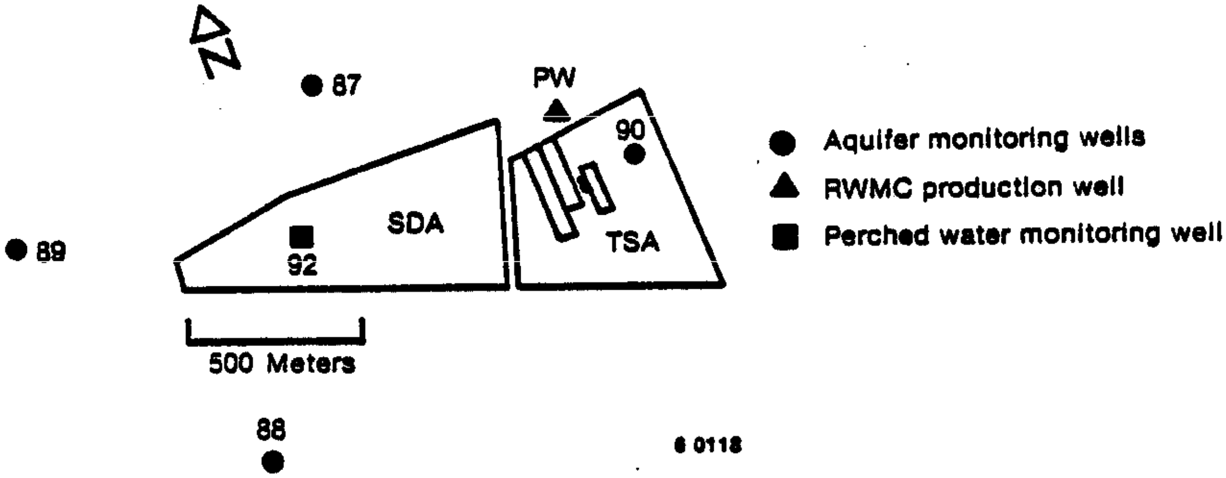

Figure 4.16.3. USGS well locations in and adjacent to the RWMC.

TABLE 4.16.4. RESULTS OF RADIOCHEMICAL ANALYSES OF RWMC SUBSURFACE WATER IN 1984

Well	Month Sampled	Radionuclide	Concentration[a] (10^{-6} μCi/ml)	Percentage of CG[b]
87	January	H-3	1.4 ± 0.3	0.05
	April	H-3	1.4 ± 0.3	0.05
	July	H-3	1.3 ± 0.3	0.04
	October	H-3	1.4 ± 0.3	0.04
88	January	None	--[c]	--
	April	None	--	--
	July	None	--	--
	October	None	--	--
89	January	None	--	--
	April	None	--	--
	July	None	--	--
	October	None	--	--
90	January	H-3	2.1 ± 0.3	0.07
	April	H-3	1.9 ± 0.3	0.06
	July	H-3	1.5 ± 0.3	0.05
	October	H-3	1.2 ± 0.3	0.04
RWMC Production Well	January	H-3	1.8 ± 0.3	0.06
	April	H-3	1.5 ± 0.4	0.05
	July	H-3	2.1 ± 0.3	0.07
	October	H-3	1.7 ± 0.3	0.06
		Am-241	0.000015 ± 0.000006	0.0004
92	April	None	--	--
	October	None	--	--
Natural Background		H-3	0.05 to 0.1	--

a. Analytical uncertainties presented are ± 1σ.

b. Detected concentration as a percentage of Concentration Guide (CG) values for uncontrolled areas from DOE Order 5480.1A. Chapter XI, Table II, Column 2.

c. -- Not applicable.

TABLE 4.16.5. RESULTS OF CHEMICAL ANALYSIS OF SUBSURFACE WATER AT THE RWMC IN 1984

Well	Month Sampled	Specific Conductance 10^{-4} (mhos/cm)	Concentration (mg/L or ppm)[a] Cl⁻	Na+
87	January	2.8 ± 0.3	14 ± 1	--
	April	2.9 ± 0.3	14 ± 1	--
	July	2.8 ± 0.3	11 ± 1	--
	October	3.0 ± 0.3	15 ± 2	12 ± 1
88	January	6.1 ± 0.3	137 ± 14	--
	April	6.1 ± 0.3	105 ± 10	--
	July	5.8 ± 0.3	130 ± 13	--
	October	5.4 ± 0.3	98 ± 10	47 ± 5
89	January	3.2 ± 0.3	36 ± 4	--
	April	3.1 ± 0.3	27 ± 3	--
	July	3.0 ± 0.3	32 ± 3	--
	October	3.3 ± 0.3	26 ± 3	15 ± 2
90	January	3.1 ± 0.3	12 ± 1	--
	April	3.0 ± 0.3	10 ± 1	--
	July	2.9 ± 0.3	11 ± 1	--
	October	3.3 ± 0.3	12 ± 1	10 ± 1
RWMC Production Well	January	3.2 ± 0.3	13 ± 1	--
	April	3.1 ± 0.3	10 ± 1	--
	July	2.9 ± 0.3	12 ± 1	--
	October	2.9 ± 0.3	11 ± 1	8 ± 2
92	April	8.0 ± 0.3	69 ± 7	--
	October	8.5 ± 0.3	68 ± 7	--[b]
Natural Background (of aquifer)		300 - 325	8 - 15	8 - 20

a. Analytical uncertainties presented are ± 1σ.

b. Not analyzed.

4.16.3.3 Soils. Since small- mammal burrowing is a mode of radionuclide transport, excavated soils were collected from small-mammal burrows in the five major areas of SDA (see Figure 4.16.4). The samples were analyzed using gamma spectroscopy and radiochemistry. The results are presented in Table 4.16.6. Results are similar to those of routine soils. The concentrations detected through radiochemistry analysis also fall within normal ranges for that area.

Nitrate analysis was performed on soil samples from the RWMC. Results of nitrate analysis of Pad A soil samples are shown in Figure 4.16.5. The pattern among these data is consistent, with the exception of the spring of 1984. It is thought that the addition of new soil spread over the area in the fall of 1983 influenced the drainage ditch data. Measured nitrate concentrations for all other samples taken in the spring of 1984 are unusually high. If error in laboratory analysis can be ruled out, then some unusual source of nitrates raised the surface soil concentrations over a wide area. Possible sources of these nitrates are the waste in the Pad A mound or the soil used for final cover. There is no apparent trend of increase or decrease in the Pad A ditch soil concentrations from 1980 through 1984.

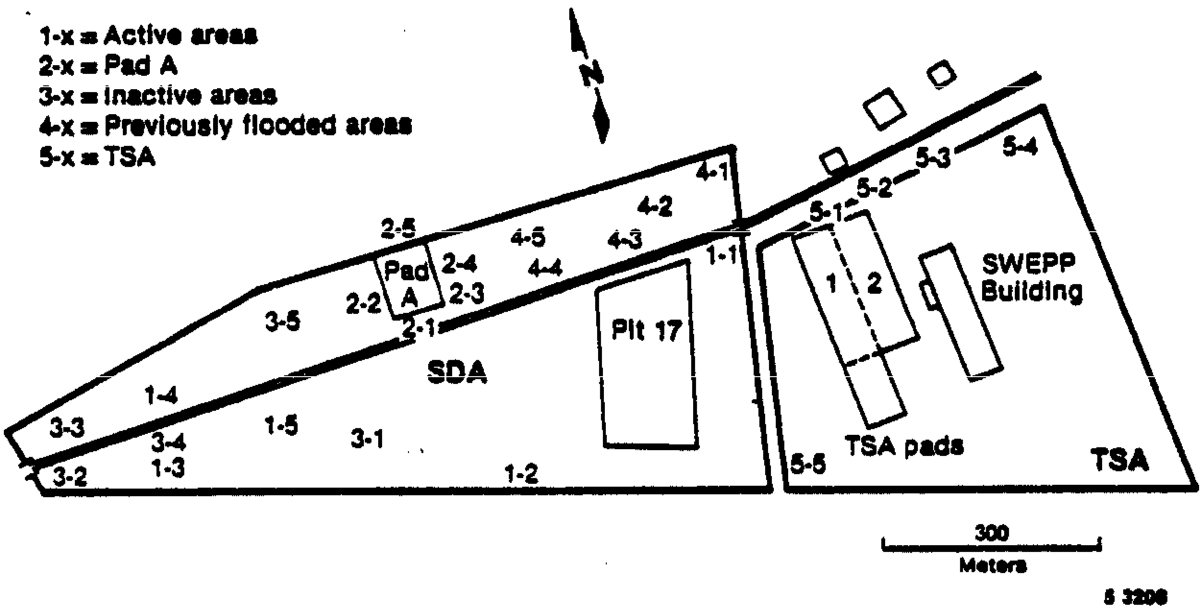

Figure 4.16.4. RWMC soil-sampling locations.

TABLE 4.16.6. EXCAVATED SOIL SAMPLES FROM SMALL-MAMMAL BURROWS

Location	Radionuclide	Concentration[a] (10^{-6} μCi/ml)
1-2	Co-60	0.77 ± 0.14
	Sr-90	0.11 ± 0.01
	Pu-239, 240	0.37 ± 0.04
	Am-241[b]	1.3 ± 0.2
1-3	Ce-144	0.90 ± 0.16
2-1	Am-241	0.66 ± 0.9
	Sr-90	0.4 ± 0.1
	Pu-239, 240	0.22 ± 0.05
2-2	Cs-137	0.94 ± 0.24
4-1	Am-241	2.1 ± 0.2
	Sr-90	0.6 ± 0.1
	Pu-239, 240	1.0 ± 0.2
4-2	Am-241	32. ± 3.0
	Sr-238	0.32 ± 0.04
	Pu-239, 240	16.5 ± 0.8
4-3	Sr-90	0.5 ± 0.1
	Cs-137	0.45 ± 0.10
	Pu-239, 240	0.46 ± 0.09
	Am-241	1.8 ± 0.5
5-1	Cs-137	0.38 ± 0.12

a. Analytical uncertainties presented are ± 1σ.

b. All the americium results shown here are from radiochemical analysis.

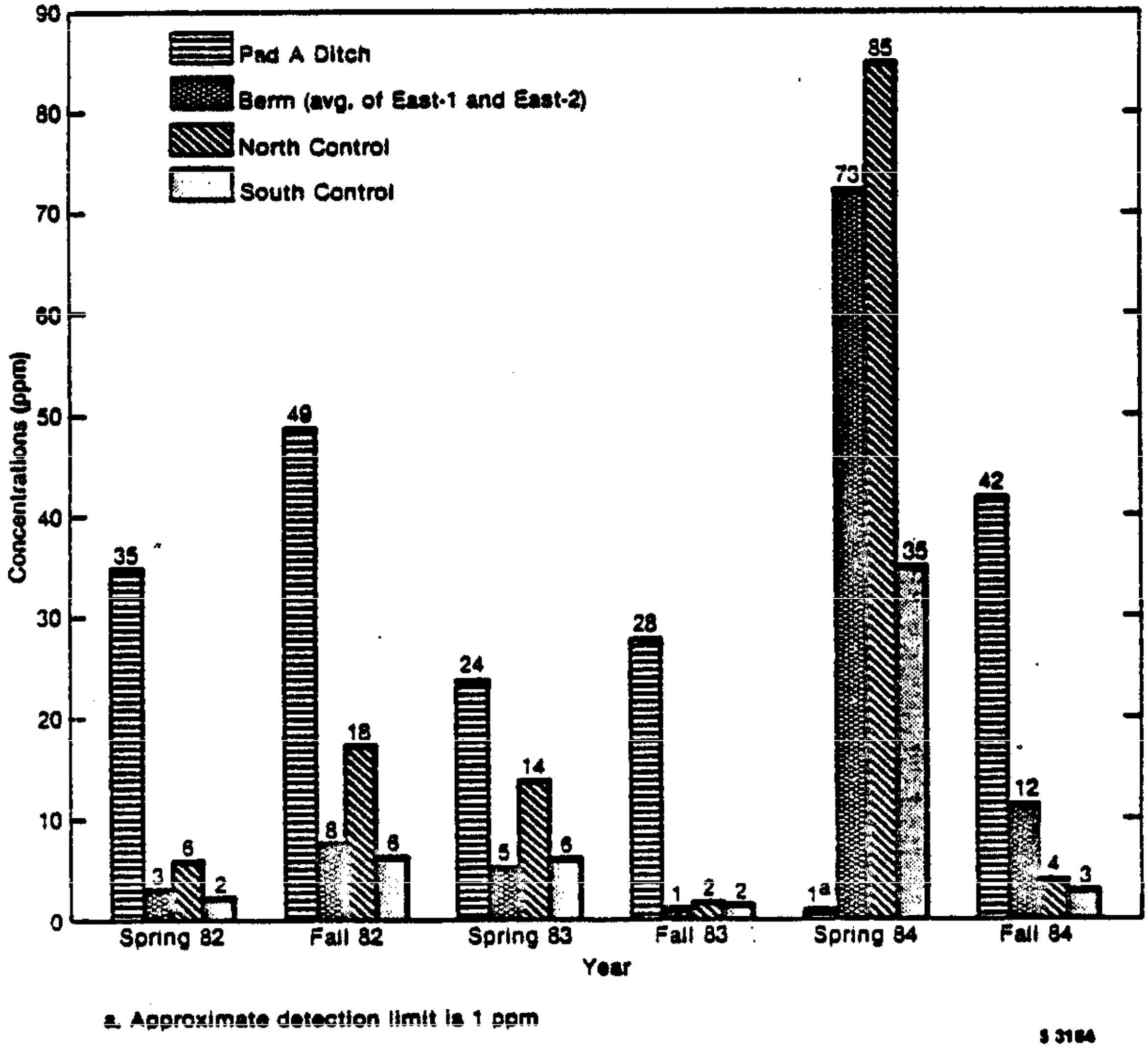

Figure 4.16.5. Nitrate concentrations in soils from Pad A.

5. CONCLUSIONS

The purpose of the Phase I, Installation Assessment Report is to locate and identify those inactive hazardous waste disposal sites that may pose a potential threat to health, safety or the environment as a result of hazardous substance migration. The proceeding section presented the findings of document searches and personnel interviews. The conclusions given in this section are based on those findings and are presented according to the general geographical divisions made in Section 4. Table 5.1 contains the priority ranking of potential contamination sources within the INEL which are operated or controlled by EG&G Idaho, Inc. The rankings are based on scores obtained using the EPA Hazard Ranking System (HRS) for chemical hazards and the DOE modified HRS (MHRS) for hazards due to radioactive contamination. The priority listing is based on the higher score of the two ranking systems. Appendix E is a compilation of the individual site work sheets which were used to determine the HRS and MHRS scores.

5.1 Test Reactor Area (TRA)

5.1.1 TRA-758, Warm-Waste Pond

Sections of the Warm-Waste Pond have been active since 1952 and have more or less continuously received low-level radioactively contaminated wastewater since that time. The chemical hazardous constituent of primary concern is chromium, which was sent to the pond from 1952 through about 1964 in the form of cooling water treated with chromates. The site received a score of 51.9 on both the HRS and the MHRS. The high score was due in large part to the fact that a migration path exists between contaminants in the pond and the Snake River Plain Aquifer. Measurable contaminants in the aquifer that can be linked to the Warm-Waste Pond are limited to specific radionuclides. Migration of chromium from the pond to the aquifer has not been verified, but chromium has been found in a perched water table that exists beneath much of the TRA site. Without considering

TABLE 5.1. HAZARD RANKING SCORES FOR EG&G SITES

Site	High Score	HRS	MHRS
TRA Warm-Waste Leach Pond	51.9	51.9	51.9
TRA Warm-Waste Retention Basin	41.9	22.0	41.9
TRA Waste Disposal Well	39.9	39.9	0
TSF Injection Well	31.6	31.6	9.2
CFA Landfill	17.7	17.7	0
WRRTF Injection Well	14.5	14.5	1.3
ARA-II SL-1 Burial Ground	13.7	0	13.7
TRA Chemical Waste Pond	12.0	12.0	0
PBF Corrosive-Waste Injection Well (PBF-302)	12.0	12.0	0
CF-674 Pond	12.0	12.0	0
TSF RPSSA/TSF-1 Area	11.4	0	11.4
TSF Disposal Pond	10.5	10.5	3.2
ARA-III Radioactive-Waste Leach Pond	10.5	10.5	5.8
ARA-III Sanitary Sewer Leach Field (ARA-740)	10.0	10.0	0
TSF TAN-607 Mercury Spill	9.5	9.5	0
IET Injection Well (TAN-332)	9.5	9.5	0
Minor spills at TRA Open Loading Dock (TRA-722)	9.2	9.2	0
RWMC	9.0	9.0	9.0
CFA Motor Pool Pond	8.5	8.5	0
OMRE Leach Pond	7.8	7.1	7.8
CFA Sewage Drain Field	7.8	0	7.8
CF-633 French Drain	7.8	7.8	0

TABLE 5.1. (continued)

Site	High Score	HRS	MHRS
TSF TAN-607 Fuel Spill	7.3	7.3	0
LOFT TAN-629 Diesel Fuel Spills	7.3	7.3	0
TRA Acid Spill (TRA-608)	7.1	7.1	0
TRA Paint Shop Ditch (TRA-606)	7.1	7.1	0
EOCR Leach Pond	7.1	7.1	0
TSF Service Station Spill (TAN-664)	6.8	6.8	0
WRRTF Burn Pit	6.8	6.8	0
WRRTF Two-Phase Pond (TAN-763)	6.3	6.3	0
LOFT Disposal Pond (TAN-750)	6.3	6.3	5.8
SPERT I Corrosive-Waste Seepage Pit (PBF-750)	6.0	6.0	0
NODA	5.9	5.9	0
TSF Burn Pit	5.8	5.8	0
WRRTF Evaporation Pond (TAN-762)	5.3	5.3	0
ARA-I Chemical Leach Field (ARA-745)	5.3	5.3	0
SPERT-III Small Leach Pond	5.0	5.0	0
SPERT IV Leach Pond (PBF-758)	5.0	5.0	0
WRRTF Radioactive Liquid Waste Tank (TAN-735)	4.6	0	4.6
SPERT II Leach Pond	4.5	4.5	0
PBF Warm-Waste Injection Well (PBF-301)	4.2	0	4.2
PBF Evaporation Pond (PBF-733)	4.0	4.0	0
TSF Gravel Pit	3.8	3.8	0
BORAX II-V Leach Pond	3.8	3.8	2.4
LCCDA	3.7	3.7	0

TABLE 5.1. (continued)

Site	High Score	HRS	MHRS
TSF Intermediate-Level (Radioactive) Waste Disposal System	3.4	3.4	2.7
BORAX-I Burial Site	2.5	0	2.5
IET Hot-Waste Tank (TAN-319)	2.4	2.4	0.1
ARA I Sanitary Waste Leach Field	1.6	0	1.6
ARA-I Pad Near ARA-627	0.3	0	0.3
IET Septic Tank	0	0	0

other physical conditions, the potential for chromium migration must also be considered to be present since an avenue of radionuclide migration has been shown to exist.

5.1.2 TRA-712, Warm-Waste Retention Basin

The wastewater that flows to the Warm-Waste Pond first passes through this retention basin, which has also been in use since 1952. The basin was discovered to be leaking in the early 1970's and has since been contributing the same contaminants to the perched water table as has the Warm-Waste Pond. The same avenue of migration exists for the wastewater in this basin, and it must therefore be assumed that radionuclides reaching the aquifer may have come from this source as well as from the pond. However, significant chemical contamination from the Retention Basin is not suspected, since chromium was not discharged to this waste stream after October 1964. The site received an MHRS score of 41.9 and an HRS score of 22.0. The scores were lower than those of the Warm-Waste Pond because quantities discharged to the ground were smaller and no chromium release was suspected.

5.1.3 TRA Waste Disposal Well

This injection well was operational from 1964 to 1982 and was used to inject water (then considered nonhazardous) directly into the Snake River Plain aquifer. The well is perforated at several intervals between 156 and 386 m; the aquifer starts at about 145 m. The only identified contaminant of concern that was sent to the well was the chromated cooling water that had previously gone to the Warm-Waste Pond. Chromates were used in the cooling water until 1972. The USGS reported a definable chromium plume in the aquifer during the period from the mid 1960's to the mid 1970's. But their most recently published hydrological characterizations show no such definable plume. It seems reasonable to assume that the significant contamination from this activity has already migrated and dispersed into the aquifer and that contamination above background is therefore no longer detectable. However, the site received a relatively high HRS score (39.9) because an observed release was assumed.

5.1.4 TRA Chemical Waste Pond

This pond undoubtedly received corrosive wastewater (acidic and basic solutions) from 1962 to 1984 and has received pre-neutralized wastewater since that time. The water reaching this pond has the same potential for migration as does water going to the TRA Warm-Waste Pond since they would both contribute to the same perched water table. However, it is unlikely that this pond would ever have contributed any hazardous constituents to the migration path. In-pond neutralization due to mixing of acidic and basic solutions, the natural buffering capacity of the soil, and dilution with the perched water table could all contribute to preventing any corrosive characteristics from migrating to the aquifer. This site appears to have a low potential of presenting a threat to health, safety or the environment and has an HRS score of 12.0.

5.1.5 TRA-722, Open Loading Dock

The potential for migration of contaminants from this site is basically unknown, although it is expected to be minimal. Any contamination release would be due to spillage/leakage from drums of unused petroleum products and solvents. The extent of such releases is unknown but residues were visible beneath the dock. The site obtained an HRS score of 9.2 by assuming a conservatively high release quantity.

5.1.6 TRA Acid Spill (TRA-608)

This 1983 spill of 379 L (100 gal.) of sulfuric acid should present no significant potential for contaminant migration. It received an HRS score of 7.1. This incident was scored because the release exceeded the Reportable Quantity of 1,000 pounds for sulfuric acid as identified in 40 CFR Part 302.

5.1.7 TRA Paint Shop Ditch (TRA-606)

The open disposal of approximately 10,400 L of paint thinners and solvents should present little potential for contaminant migration because of the relatively low persistence of the waste involved. The fact that the waste was disposed of in small increments decreases the chances of the material's being pushed to any depth. The site received an HRS score of 7.1.

5.2 Test Area North/Technical Support Facility (TAN/TSF)

5.2.1 TSF Injection Well (TAN-330)

The TSF Injection Well received an HRS score of 31.6, which is the highest score for sites within TAN. The relatively high score was due largely to the fact that it was judged to have an observed release even though there were no specific analytical results to verify this. The logic in assuming such a release is based on the fact that the well allowed discharge directly to the Snake River Plain Aquifer. Although minor amounts of chromium, lead, and mercury are suspected of going to the well, corrosive waste was the major hazardous constituent discharged. There would appear to be limited potential for additional migration occurring from the site since it was operative from 1955 to 1972. USGS sampling of groundwater has not identified a contamination plume from the site, and it is suspected that, if there ever were such a plume, it has been diluted and dispersed so that it is no longer detectable. The site received an MHRS score 9.2 due to minor amounts of radioactivity that were released. The activity was due almost entirely to tritium.

5.2.2 TSF Radioactive Parts Security and Storage Area (RPSSA)/TSF-1 Area

The RPSSA was ranked solely because of radioactive contamination. It received an MHRS score of 11.4. Even though a sizeable portion of the area's surface has been characterized by D&D efforts, the exact extent of contamination is unknown. In order to obtain the 11.4 score, a maximum value for radioactive waste characteristics was assumed. It is suspected that there are several items with significant activity buried in the area, but the migration potential is low because the radioactive contamination is generally limited to particulates which should be readily attenuated by the soil column should they be moved by precipitation or runoff.

5.2.3 TSF Disposal Pond, TAN-736

This percolation pond has received miscellaneous wastewater since 1972. Prior to 1984, these wastewaters may have contained hazardous constituents as well as minor amounts of radiological contamination. The site received an HRS score of 10.5 (due to the chemical contamination) and an MHRS score of 3.2 (due to the radioactivity). The fact that the pond continues to receive water definitely increases the potential for migration, but it is questionable whether the actual pond water has ever been hazardous, at least by RCRA definitions. The most significant volume of hazardous constituents identified as going to the pond are corrosives that may have been neutralized by the time they were discharged. The potential for migration of liquid from the pond may be significant but the hazards presented by the contaminants involved appear to be small.

5.2.4 TSF Mercury Spill

This mercury spill was identified through an interview with personnel who were involved. There was an attempt made to retrieve the spilled material, but it is unknown how much of the estimated four liters was actually recovered. The spill occurred in early 1960, and the amount unrecovered probably exceeded the one-pound Reportable Quantity for mercury. The site was therefore ranked and received a score of 9.5. Considering the small quantity involved and the time since the spill occurred, the potential for any additional migration appears small.

5.2.5 TSF Fuel Spill, TAN-607

This 1982 spill from a diesel fuel tank was given an HRS score of 7.3. Five hundred gallons of fuel were released at the time the tank leak was discovered, but it is unknown how much fuel may have leaked into the ground beneath the tank before the discovery was made. For scoring purposes a conservatively high release estimate of 2,050 to 12,500 gallons was assumed. As the score would indicate, the potential for significant migration still appears to be small.

5.2.6 TSF Service Station Spill, TAN-664

This gasoline spill occurred in 1981/1982 and involved a reported 821 L (217 gal.). The incident received an HRS score of 6.8. Considering the small quantity involved in the spill and the high vapor pressure of the material spilled, it is unlikely that much residue remains for migration. The present threat to health, safety, or the environment from this spill is considered minimal.

5.2.7 TSF Burn Pit

This combination landfill/burn pit area was operated from about 1953 to 1958. There were no significant quantities of hazardous wastes identified as going to this pit, but it is suspected that some waste petroleum was disposed of here. The site received an HRS score of 5.8, but this did not take into consideration the fact that the materials going to the pit were reportedly burned on a frequent basis. Although there is limited information available on the wastes disposed of here, the suspected small quantity of hazardous wastes, and the fact that such waste may have been destroyed (or at least made less mobile), make the potential for contaminant migration small.

5.2.8 TSF Gravel Pit

The only identified hazardous waste disposal at this gravel pit was one drum (55 gal.) of sulfuric acid. The site was ranked and given a score of 3.8 but could have justifiably been omitted from the process because the quantity released was less than the 1,000-pound Reportable Quantity for sulfuric acid. The potential for contaminant migration appears to be insignificant.

5.2.9 TSF Intermediate-Level (Radioactive) Waste Disposal System

Two large underground tanks, which are components of this system, received radioactively contaminated waste from 1955 to 1975. These tanks still contain sludge which has both hazardous chemical and radiological constituents. The radiological contamination produced an MHRS score of 2.7 and the chemical contamination produced an HRS score of 3.4. The scores, as well as the migration potential, are very low because the tanks are reported to be sound and sit in a concrete secondary containment cradle.

5.3 Test Area North/Loss-of-Fluid Test (TAN/LOFT) Facility

5.3.1 LOFT Diesel Fuel Spills at TAN-629

During two events (one in 1982, the other in 1983), approximately 5,500 gallons of diesel fuel were spilled in the same ditch at the LOFT facility. The site received an HRS score of 7.3, which indicates a low potential for migration problems. Because of the limited amount of precipitation in the region, the fuel would probably not be carried or pushed very deep and should have had considerable opportunity to evaporate or to be biologically broken down.

5.3.2 LOFT Disposal Pond (TAN-750)

The LOFT Disposal Pond has received wastewater since 1971 and was scored for both chemical and radiological contamination. The HRS score was 6.3 and the MHRS score 5.8. Since it is a percolation pond, migration of the water is expected, but there has been no evidence that any contaminants have reached the aquifer. The only significant quantities of hazardous wastes shown as having been sent to the pond are corrosive ion-exchange regenerants. Limited records show that these were neutralized before reaching the pond. Carbon tetrachloride was not used for the toxicity/persistence element of the HRS score because the total amount of carbon tet*** released was less than the Reportable Quantity established by EPA. As indicated by the MHRS score, the quantity of radiological contamination is small. Even though wastewater is still discharged to the pond, the potential for hazardous contaminants to migrate appears small.

5.3.3 Sites Within the LOFT Facility Which Were Not Scored

The LOFT Injection Well was not scored because there were no records indicating hazardous or radiological wastes had ever gone there. The acid spill that occurred in 1983 on the northeast side of TAN-629 was not scored because the records show that the spilled acid was either removed or neutralized. There should be no potential for migration of contaminants from these sites.

5.4 Test Area North/Initial Engine Test (TAN/IET) Facility

5.4.1 IET Injection Well (TAN-332)

The IET Injection Well received wastewater from 1956 to 1978. The HRS score was 9.5. The ranking work sheets (Appendix E) show an observed release from this site since the well injected directly to the Snake River Plain Aquifer. However, there were no analytical results showing an increase in contaminants in the aquifer. The only hazardous constituents going to the well were ion exchange regenerants that were mixed and at least partially neutralized prior to discharge. Any potential for migration of contaminants from this site should have been exhausted long ago. Any corrosive characteristic water reaching the aquifer has undoubtedly been diluted and buffered to background levels.

5.4.2 IET Hot-Waste Tank (TAN-319)

This tank was part of the facility's radioactively contaminated waste collection system that was periodically active from 1956 to 1978. The tank and its sludge contents received an MHRS score of 0.1 because of radiological contamination and an HRS score of 2.4 because of suspected mercury contamination. There are no analytical data indicating that mercury is present, and it probably should not have been scored. However, mercury has been found in associated piping already removed. In order to get an impression of the migration potential (as determined through the HRS) the sludge was considered to be totally contaminated. As the low score would indicate, even under worst-case conditions, the potential is minimal.

5.4.3 IET Septic Tank

The IET Septic Tank, not used since 1978, was found to have minor radiological contamination originating from an unknown source. The site was ranked using the MHRS, but the contamination was so minor the score was zero. The tank should pose no problem in the form of potentially significant contaminant migration.

5.5 Test Area North/Water Reactor Research Test Facility (TAN/WRRTF)

5.5.1 WRRTF Injection Well (TAN-331)

The injection well was operational from 1957 to 1984. Except for one incident in which a small amount of radioactivity was apparently released, the only potentially hazardous discharges were ion-exchange column regenerant. The site received an HRS score of 14.5 and an MHRS of 1.3. The scores were based on an observed release because the well injected directly into the aquifer. However, it was reported that the corrosive regenerants were neutralized prior to release to the injection well. The scoring was based on the conservative estimate that no neutralizing was done; if the discharge was always neutralized the HRS score would be zero. In any event, the regenerants would have been buffered and/or diluted by the aquifer and there should be no further threat to safety, health or the environment.

5.5.2 WRRTF Burn Pit

This combination landfill/burn pit was operated from about 1958 to 1967. It received the same waste that had previously gone to the TSF Burn Pit and was operated in the same manner. There were no significant quantities of hazardous waste reported as having been discharged to this pit, but disposal of various petroleum products is suspected. The site received an HRS score of 6.8, but this did not take into account that the waste was frequently burned. As with the TSF Burn Pit, records are nonexistent, but the quantities of hazardous waste are suspected to be small and the frequent burning should have decreased the potential for any migration problems. Zinc bromide was not used for the "toxicity/persistence" portion of the scoring because it is highly unlikely that more than the Reportable Quantity was ever disposed of.

5.5.3 WRRTF Two-Phase Pond (TAN-763)

This percolation pond has been used since 1981 to receive wastewater with small concentrations of hydrazine. The HRS score of 6.3 (shown in Table 5.1) is based on the assumption that about 3.5 L of hydrazine were discharged to the pond. Since hydrazine is such a strong reducing agent, it is unlikely that the wastewater could migrate far through the ground without reacting. The potential for migration of a hazardous substances from this site appears very small.

5.5.4 WRRTF Evaporation Pond (TAN-762)

This evaporation/infiltration pond, which is the enlarged south cell of the sewage lagoons, receives the wastewater that previously went to the WRRTF Injection Well. It has been in use since 1984 and received an HRS score of 5.3. The score is based upon the assumption that no neutralizing of the corrosive ion-exchange regenerants was done before discharge. However preneutralization is suspected and there are no other identified hazardous constituents involved. Therefore, it is likely that there are no hazardous materials in the pond and that the potential for migration is therefore non-existent.

5.5.5 WRRTF Radioactive Liquid Waste Tank (TAN-735)

Radiological contamination is suspected to be present in the sludge that remains in this tank. Maximum radioactive waste characteristics were assumed in order to obtain an MHRS score of 4.6. This score indicates that little migration potential exists and that using the maximum number for the waste characteristic element is probably unrealistic, considering the type of wastewater that went through the tank (i.e. low enough activity for uncontrolled release). Should the tank sludge be sampled and the results used to rescore the site, it is suspected that the new MHRS score would be still lower.

5.6 Auxiliary Reactor Area (ARA)

5.6.1 ARA II, SL-1 Burial Ground

This burial ground was established just northeast of the ARA II site to receive materials and debris resulting from the explosion of the SL-1 reactor in 1961. Highly contaminated (radioactive) materials, including the reactor vessel, were buried here. The site received an MHRS score of 13.7 and an HRS score of zero since no chemical hazardous wastes are suspected to be present. Asphalt was placed over the burial site to help stabilize it. There have been no other physical controls installed to prevent migration but it seems unlikely that there will ever be sufficient water passing through the buried materials to cause any leaching problems. The site is not considered a recharge area and precipitation is considerably lower than the evapo-transpiration rate. Surface monitoring is being done, and will continue to be done, around the site to ensure that surface migration does not become a problem.

5.6.2 ARA III, Radioactive Waste Leach Field

This percolation pond has received small quantities of both radiological and chemical contamination. It received an HRS score of 10.5 and an MHRS score of 5.8. There has been no wastewater intentionally discharged to the pond since 1965; however, a small amount of water still flows into it. It is suspected that the continuing discharge is clean water but it could aid in the migration of any contaminants already in the pond sediments. The review of past operations indicates that the quantity of such contaminants is small and no migration has been detected in monitoring wells. However, the number of monitoring wells in the area is probably insufficient to ensure the detection of any releases.

5.6.3 ARA III, Sanitary Sewer Leach Field (ARA-740)

From 1980 through 1983, very small quantities of laboratory wastes have gone to this septic tank/drainage field system. The drainage field received an HRS score of 10.0 due to this contamination. The continued use of the sewer system contributes to migration potential but there is no analytical data available to indicate which contaminants, if any, have reached the leach field and whether or not they have moved. With the small quantities of hazardous constituents involved, the seriousness of migration from this source would be relatively small, even as a worst case.

5.6.4 ARA I, Chemical Leach Field

This percolation pond has been used since 1971 for miscellaneous wastewaters. The small quantities of hazardous waste suspected are due to laboratory operations and were responsible for the HRS score of 5.3. The wastewater continuing to be discharged to the leach field increases the potential for migration, but the small quantities of wastes involved would minimize the significance of any such migration. The quantities of individual contaminants identified as going to this site were actually below their respective Reportable Quantities, as identified in 40 CFR Part 302. A strict application of the HRS would have excluded these wastes from the scoring process and the resulting score would be zero.

5.6.5 ARA I, Sanitary Waste Leach Field

Health Physics surveys of this leach field indicate minor radiological contamination. The source of the contamination is unknown but is suspected to be residue from the SL-1 incident and its cleanup. The site received an MHRS score of 1.6 and should present no significant potential for contaminant migration that would pose a threat to health, safety, or the environment.

5.6.6 ARA I, Pad Near ARA-627

The contamination involved in this site is due to a source of radiation located under a trailer pad. The source is suspected to be residue left from the SL-1 cleanup operation. The contamination is isolated, is undoubtedly particulate, and appears to be stable as far as location. The site received an MHRS score of 0.3 and should pose no threat of migration.

5.7 Power Burst Facility (PBF)

5.7.1 PBF Corrosive Waste Injection Well (PBF-302)

This injection well was active from 1972 through 1978 and received corrosive ion-exchange column regenerant and cooling water treated with chromates. The well terminated at a depth of 35 m (115 ft), about 104 m (340 ft) above the surface of the Snake River Plain Aquifer. Assuming all the regenerant solutions were hazardous, the site was given an HRS score of 12.0. From recent discharge data there seems to be a good chance that the regenerants have always been neutralized (due to mixing) before they were released to the well. It is also unlikely that corrosive characteristics would have remained after migration through a soil column. This leaves the chromium as the primary constituent of concern for migration. Since the well has not received water in over seven years and the location is not considered an aquifer recharge area, it is likely that the hazardous waste constituents have migrated as far as they will. Monitoring data are insufficient to determine whether or not detectable levels have ever reached the aquifer. The potential for significant quantities of contamination to migrate from this site in the future appears to be small.

5.7.2 SPERT I Corrosive Waste Seepage Pit (PBF-750)

This 5-m (15-ft) deep seepage pit received corrosive ion-exchange column regenerant solutions from 1955 through 1964. The site received an HRS score of 6.0 based on the estimated quantities of sulfuric acid and sodium hydroxide that were used to make up the regenerant solutions. As with other sites that received this type waste, the corrosive characteristics of the wastewater that went to this site are not expected to have remained with the water for long due to the buffering capacity of the soil. Continuing migration of contamination from this site does not appear to be a problem.

5.7.3 SPERT III Small Leach Pond

This percolation pond received ion-exchange column regenerant solutions from 1958 to 1968. These corrosive solutions resulted in an HRS score of 5.0 for the pond. No other hazardous wastes are suspected in this pond. The potential for hazardous waste to migrate from this pond is very small.

5.7.4 SPERT IV Leach Pond (PBF-758)

This percolation pond was used from 1961 to 1970 for disposal of chemically contaminated wastewater from a demineralization plant and radioactively contaminated wastewater from reactor operations. Chemical contamination was limited to corrosive ion-exchange column regenerants resulting in an HRS score of 5.0. The radiological contamination was always small enough that DOE release criteria were not exceeded. Also, recent radiological surveys of the surface area have shown activity readings comparable to background. Therefore, the site was not scored for radiological contamination. Significant migration of chemical contamination from this site is not expected to occur.

5.7.5 SPERT II Leach Pond

As with the SPERT IV Leach Pond, this percolation pond was used for the disposal of wastewater from a demineralization plant and low-level radioactive wastewater from reactor operations. It received these wastewaters from 1960 to 1964. The pond was not scored for radioactive contamination because the discharges had always been very low in activity and recent surveys have shown only background levels. The site received an HRS score of 4.5 which is lower than the SPERT IV Pond score because the quantity of chemicals was less. Again, migration of corrosive contaminants is not expected to present a problem. The quantities of individual hazardous constituents were actually small enough to be lower than their respective Reportable Quantities. A stricter application of the HRS would actually have led to a score of zero.

5.7.6 PBF Warm-Waste Injection Well (PBF-301)

This injection well was active from 1973 to 1984 when it was capped. It received low-level radioactive wastewater and uncontaminated raw cooling water. (Discharge of radioactive wastewater was discontinued in 1980 while the cooling water discharge continued until 1984.) The well terminated at 34 m (110 ft), about 105 m (345 ft) above the Snake River Plain Aquifer. The well received no HRS score and an MHRS score of 4.2 due to the radiological contamination. It is suspected that there is little potential for additional migration of contaminants from this site, and the amount of contamination in the ground is relatively small.

5.7.7 PBF Evaporation Pond (PBF-733)

Since 1979 this Hypalon-lined pond has received ion-exchange column regenerant solutions (potentially corrosive) and blowdown from the reactor's secondary cooling system (pretreated with chromates until 1984). The pond received a relatively low score of 4.0 since the liner should prevent migration of chrome, which is the contaminant of primary concern.

5.8 Experimental Organic Cooled Reactor (EOCR)

5.8.1 EOCR Leach Pond

The only site within EOCR identified as having received hazardous wastes is this percolation pond. It was active from 1960 to 1962 and received ion-exchange column regenerants. These corrosive wastewaters resulted in an HRS score for the site of 7.1; no other hazardous materials were identified as going to this pond. The potential for migration of hazardous constituents from this pond is very low because of the natural buffering capacity of the soil.

5.9 Organic Moderated Reactor Experiment (OMRE)

5.9.1 OMRE Leach Pond

The only site within OMRE identified as having received hazardous wastes is this percolation pond. The pond was active from 1959 through 1963 and primarily received radiologically contaminated wastewater. Records also indicated that the pond received small amounts of waste xylene. The site received an MHRS score of 7.8 for the radiological contamination and an HRS score of 7.1 due to the xylene. Xylene has a relatively low persistence and should not offer a significant threat of migration. The radionuclides present are also small in quantity and, with no further discharges pushing them down, should not present a potential for additional migration.

5.10 Boiling Water Reactor (BORAX) Area

5.10.1 BORAX II-V Leach Pond

This percolation pond was used from 1955 to 1964 for wastewaters from the BORAX II, III, IV, and V tests. The only significant chemical contaminants identified as definitely going to the pond were ion-exchange column regenerants (acids and bases). The pond also received low-level radioactively contaminated wastewater. The site received an HRS score of 3.8 due to the corrosive waste and an MHRS score of 2.4 due to the estimated amount of radioactivity remaining at the site. As the scores would indicate, the types and quantities of hazardous contaminants present would not appear to pose a threat (due to migration) to health, safety or the environment.

5.10.2 BORAX I Burial Site

Much of the remnants of the BORAX I reactor, including the reactor vessel and shield tank, were buried at this location. Radioactivity is the primary contaminant of concern; no significant quantities of any other hazardous materials are suspected. The site received an MHRS score of 2.5. Due to the lack of moisture in the region and the condition of the contaminated waste (dry solids), the migration potential is low.

5.11 Experimental Breeder Reactor-I (EBR-I)

There were no disposal sites identified in association with the EBR-I operation.

5.12 Zero Power Reactor-III (ZPR-III)

There were no disposal sites identified in association with the ZPR-III operation.

5.13 Liquid Corrosive Chemical Disposal Area (LCCDA)

This area consisted of two pits used for the disposal of corrosive (acids and bases) liquids. One pit was used from 1961 through 1970 while the other, which had limestone placed in the bottom, was used from 1972 to 1980. The site received significant quantities of waste, including liquids, but because of the corrosives' relatively low persistence and the location of the site, it received an HRS score of only 3.7. Due to the buffering capacity of the soil, it is not expected that waste with corrosive characteristics could migrate to any significant extent.

5.14 Munition/Ordnance Areas

5.14.1 Naval Ordnance Disposal Area (NODA)

This site received an HRS score of 5.9 for its past use as a storage site for hazardous waste. There is analytical evidence that some of the waste may have been spilled or leaked on the ground. However, there are no records of such spills occurring, so an estimated release was used to obtain the score. Although it is suspected that some relatively persistent compounds such as methylene chloride may have been released, the quantities are also suspected to be quite small and should not present a significant potential for migration.

5.14.2 Miscellaneous Munition/Ordnance Areas

There were numerous sites identified in Section 4.14 where unexploded ordnance have been found or are expected to be located. These sites, which include the NODA, were not scored because they are not readily adaptable to the HRS and basically present an "unknown" in quantity. The materials of concern are solid, potentially explosive items which exhibit no significant potential for migration. The danger, rather, is in their being a safety hazard to people moving or working in uncleared (unsurveyed for explosive ordnance) areas.

5.15 Central Facilities Area (CFA)

5.15.1 CFA Landfill

The old CFA Landfill was the primary disposal site for nonradioactive solid waste generated on the INEL from 1951 to 1981. Records show that significant quantities of hazardous waste were discharged to this landfill. It is suspected that much of it was not documented. The site received an HRS score of 17.7 based on an assumed hazardous waste quantity derived from current generations. It was assumed that past generations were similar in quantity and that all were disposed of in the CFA Landfill. This should represent a conservatively high estimate. Free liquids, even if containerized, are expected to be present in the landfill, and the potential for migration of hazardous constituents does exist. The location of the active portion of the landfill changed in about 1981. This corresponds roughly to the timeframe when hazardous wastes were segregated and handled separately for off-site disposal. Therefore, it is assumed that no significant quantities of hazardous waste were disposed of in the newer landfill area.

5.15.2 CF-674 Pond

Investigations indicate that it is very likely that hazardous constituents went to this percolation pond, but the quantities of such materials are unknown. The pond was used from 1954 to 1965 to receive wastewater from a prototype fuel-processing operation. There is no evidence that additional wastes were sent to the site after that time. An HRS score of 12.0 was obtained, using a conservatively high estimate of hazardous waste that may have been disposed of. The potential for additional migration of contaminants from the site should be small because there have been no recent discharges to the pond and because the area climate is quite dry. However, the extent of migration, if any, that has already occurred is unknown.

5.15.3 CFA Motor Pool Pond

This percolation pond is connected to the CFA equipment repair facility that is referred to as the "Motor Pool". It was active from 1951 to 1983 and received significant quantities of battery acid during that time. The pond also undoubtedly received high levels of oil and grease, but these were not included as hazardous waste in calculating an HRS score of 8.5. The pond has received no water other than precipitation since 1983 and should present little potential for contaminant migration since only acid is involved and it was diluted with wash water at the time of discharge.

5.15.4 CFA Sewage Drain Field

The drainage field portion of the CFA Sewage Treatment Plant receives radiologically contaminated wastewater from the CFA laundry and has done so since 1953. The laundry's release criteria have become more stringent over the years, but the MHRS score of 7.8 was based on the total activity that has been discharged. The site received a relatively low score because of the physical characteristics of the INEL and because of the limited radioactivity involved. However, the fact that wastewater is still being discharged and may still be pushing contamination lower as it infiltrates increases the potential for migration. It is unknown whether such migration has occurred or if the attenuation capacity of the soil has kept all activity close to the drainage field.

5.15.5 CF-633 French Drain

This covered French drain or percolation pit received laboratory wastewater from 1950 to 1984. This water is suspected to have contained small quantities of hazardous constituents. The site received an HRS score of 7.8 based on an assumed quantity of hazardous waste that is probably conservatively high. Hazardous waste no longer goes to the drain, but since it still receives wastewater, the potential for continuing migration of contaminants is present.

5.16 Radioactive Waste Management Complex (RWMC)

This land disposal operation was designed to receive low-level radioactive wastes, but it is suspected of also containing significant quantities of radioactive-hazardous mixed wastes. The site has been active since 1952. Radioactive wastes disposed of at the RWMC have been fairly well documented, particularly in later years; records of mixed wastes, however, are minimal. The site was given maximum values of waste characteristics for both chemical and radioactive constituents and received identical HRS and MHRS scores of 9.0. Because of the large quantities of wastes, the potential for migration would appear to be significant. The site received relatively low scores because of its remoteness, dry climate, and depth to groundwater. These factors, and the fact that there are suspected minimal amounts of free liquids in the wastes, and the surface is now graded to remove precipitation, combine to reduce (to some extent) the potential for migration. The site, however, remains one of concern.

6. RECOMMENDATIONS

The basic recommendation to be made as a result of this report is to propose which sites warrant additional study. This Installation Assessment Report is Phase I of DOE's CERCLA Program, and those sites suspected of presenting a potential threat to the environment will be further characterized under Phase II of the Program.

The HRS and MHRS are attempts to put a numerical value on the potential for a site to have adverse environmental impact due to migration of hazardous materials. EPA has established an HRS score of 28.5 as a general criterion for inclusion of a site on the National Priority List (NPL). However, for the purposes of this report, the 28.5 level is not used as a minimum criterion for a site to warrant additional study. Numerous sites with comparatively low scores have been recommended for limited sampling, primarily to confirm the absence of hazardous constituents. This is especially the case for sites known or suspected of receiving only corrosive wastes, and where soil neutralization is expected to have minimized potential environmental hazards and contaminant migration.

There are also several sites described in this report which will be closed under RCRA regulations rather than under the DOE CERCLA Program. Since the closure or remedial actions for these sites will have to meet different requirements, under a different schedule, this section contains no recommendations for them.

The recommendations are presented according to the general geographical divisions used in previous sections and are summerized in Table 6.1.

6.1 Test Reactor Area (TRA)

Of the seven sites scored within TRA, only four are being recommended for continued study. Excluded are the Chemical-Waste Pond and the Paint Shop Ditch, which will both be closed under RCRA, and the Acid Spill (TRA-608) which scored 7.1 and which presents negligible potential for contaminant migration.

TABLE 6.1. RECOMMENDED MONITORING PROGRAM FOR EG&G FACILITIES UNDER PHASE II OF THE DOE CERCLA PROGRAM

Site	Rating Score	Recommended Monitoring
TRA		
1. TRA Warm-Waste Leach Pond	51.9	1.1 Sample and profile contaminants in pond sediments 1.2 Improve and continue local sampling of perched water table and Snake River Plain Aquifer 1.3 Evaluate appropriateness of existing monitoring wells to detect Contaminant migration
2. TRA Warm-Waste Retention Basin	41.9	2.1 Recommendations 1.2 and 1.3 also apply to this site
3. TRA Waste Disposal Well	39.9	3.1 No specific recommendations are made, 1.2 and 1.3 also apply
4. TRA Open Loading Dock (TRA-722)	9.2	4.1 Sampling survey of soil beneath dock
TAN/TSF		
5. TSF Injection Well	31.6	5.1 Improve and continue local monitoring of Snake River Plain Aquifer. 5.2 Evaluate appropriateness of existing monitoring wells to detect contaminant migration
6. RPSSA/TSF-I Area	11.4	6.1 Ground penetrating radar survey for buried objects 6.2 Soil sampling to characterize potential mercury spill near HTRE-3 motor, including railroad tracks.
7. TSF Disposal Pond	10.5	7.1 Sampling survey of pond sediments 7.2 Recommendations 5.1 and 5.2 also apply to this site
8. Mercury Spill (TAN-607)	9.5	8.1 Soil sampling to verify presence/absence and extent of any mercury contamination (include TAN Hot Shop).
9. TSF Burn Pit	5.8	9.1 Surface soil or core samples to verify presence/absence of persistent contaminants
TAN/IET		
10. IET Injection Well	9.5	10.1 Attempt direct monitoring of well 10.2 Recommendation 5.2 applies
TAN/WRRTF		
11. WRRTF Injection Well	14.5	11.1 Recommendation 5.2 applies
12. WRRTF Burn Pit	6.8	12.1 Surface soil sampling to verify presence/absence of persistent contaminants

TABLE 6.1. (continued)

Site	Rating Score	Recommended Monitoring
13. Evaporation Pond	5.3	13.1 Sampling survey of pond sediments
ARA		
14. ARA III Radioactive-Waste Leach Pond	10.5	14.1 Sampling survey of pond sediments
15. ARA I Chemical Leach Field	5.3	15.1 Sampling survey of pond water and sediments
16. ARA I Sanitary Waste Leach Field	1.6	16.1 Site characterization for rad contamination only
17. ARA I Pad	0.3	17.1 Site characterization for rad contamination only
PBF		
18. PBF Corrosive-Waste Injection Well	12.0	18.1 Improve and continue local monitoring of Snake River Plain Aquifer 18.2 Evaluate appropriateness of existing monitoring wells to detect contaminant migration
19. SPERT I Corrosive Waste Seepage Pit	6.0	19.1 Soil sampling to verify presence/absence of persistent contaminants
20. SPERT III Leach Pond	5.0	20.1 Sampling survey of pond sediments
21. SPERT IV Leach Pond	5.0	21.1 Sampling survey of pond sediments
22. SPERT II Leach Pond	4.5	22.1 Sampling survey of pond sediments
23. PBF Warm-Waste Injection Well	4.2	23.1 Recommendation 5.2 applies
EOCR		
24. Leach Pond	7.1	24.1 Sampling survery of pond sediments
BORAX		
25. BORAX II-V Leach Pond	3.8	25.1 Sampling survery of pond sediments
LCCDA		
26. LCCDA	3.5	26.1 Soil sampling to verify presence/absence of persistent contaminants

TABLE 6.1. (continued)

Site	Rating Score	Recommended Monitoring
MUNITIONS/ORDNANCE AREAS		
27. NODA Storage Area	5.9	27.1 Sampling survey of soil where wastes were once stored
28. Miscellaneous Munitions/Ordnance	Unscored	28.1 Pursue having DOD accept responsibility for their old materials or fund annual surveys of small areas
CFA		
29. CF-674 Pond	12.0	29.1 Sampling survey of old pond sediments
30. CFA Sewage Drain Field	7.8	30.1 Auger sampling of various locations within the drain field
RWMC		
31. RWMC	9.0	31.1 Install new wells to monitor perched water tables 31.2 Evaluate appropriateness of existing aquifer monitoring wells to detect contaminant migration

The TRA Warm-Waste Pond should be included in the Phase II confirmation effort. The pond is still being used for the disposal of low-level radioactive wastewater and does so under DOE license. There is, however, a project that has been submitted for funding that will eliminate the discharge of this wastewater to the ground. Under this project, a majority of the water will be recycled and the remainder will go to a lined evaporation pond. Any remedial action for this pond should begin by encouraging funding of this project so that the pond's usage could be halted without additional expense for alternate disposal methods that would be used only on an interim basis.

It is recommended that the Phase II effort on the Warm-Waste Pond include sampling of the pond sediments and continued sampling of the perched water table and the Snake River Plain aquifer. The pond sediments should be sampled to obtain vertical and horizontal distribution of the contaminants (primarily chromium and radionuclides). It will be valuable to know, for any future remedial action, if significant quantities of the contaminants remain near the surface or if some species have not migrated through the sediments. Additional groundwater monitoring needs to be done to determine the fate of any contaminants that have migrated. USGS is concerned about the validity of some past sampling efforts because they were primarily thief samples that may have represented isolated conditions within the well casings, and because there have been some discrepancies in analytical results. There is also some concern that chromium detected in the perched water table, as well as in the aquifer, may be partially due to naturally occurring chromium. Additional sampling of the groundwaters, after purging, needs to be done in hopes of resolving some of these issues. Finally, the locations of existing groundwater monitoring wells need to be evaluated as to their appropriateness in detecting releases from this area. As a starting point, the wells may be evaluated according to the groundwater monitoring requirements of 40 CFR 264 and 265.

With the exception of the recommendations for sediment sampling, the Phase II efforts for the Warm-Waste Pond are also applicable to the

Warm-Waste Retention Basin. Since the early 1970s, the contaminants (this timeframe excludes chromium) going to the Warm-Waste Pond have also leaked from this facility.

No specific recommendations are proposed for the TRA Waste Disposal well, since it is assumed that any adverse impact from this operation has already occurred and it no longer poses a problem due to dispersion and dilution. The improved groundwater monitoring proposed for the other TRA sites should detect any contradictions to this assumption.

The open loading dock at TRA-722 received a relatively low score (9.2) and probably exhibits a low potential for migration problems. However, the site presented an unknown problem. In order to quantify the problem, it is recommended that a sampling survey of the soil beneath the dock be conducted. The samples should be analyzed for oils and grease and the common solvents used at TRA that may have been stored on the dock (i.e., trichloroethane and methylene chloride). If detectable quantities are present at the surface, additional sampling should be done to determine both the vertical and horizontal extent of contamination.

6.2 TAN/Technical Support Facility (TAN/TSF)

It is recommended that four of the nine sites within TAN/TSF be excluded from additional study. These sites are: The Fuel Spill outside TAN-607, the Service Station Fuel Spill, the Gravel Pit and the Intermediate-Level (Radioactive) Waste Disposal system. These sites exhibit such low potential for migration that additional study is not justified.

The highest ranked of the TAN/TSF sites is the Injection Well (Score 31.6). As with other wells that injected directly to the aquifer, if problems have not yet been encountered, they probably will not occur. The only way to verify this premise is to continue monitoring. Therefore, it is recommended that the USGS monitoring of existing wells continue for an increased array of indicator parameters such as those established in 40 CFR 265 under groundwater monitoring requirements. Analysis for chromium, lead and mercury on a continuing basis is specifically appropriate. It is also recommended that the locations of the existing monitoring wells be evaluated as to their appropriateness in detecting releases from this area.

The RPSSA/TSF-1 Area scored 11.4 but probably offers little potential for migration of contaminants to the groundwater because contamination is limited to radioactive particulate at or near the surface (with possible exception of contamination from a mercury spill, see below). Migration via air releases is controlled through existing stabilization and monitoring efforts. There is no reason to suspect that the future D&D effort will not adequately address any potential problems from this area. The site received as high a score as it did because a maximum value for radioactive waste characteristics was assumed. This was based in part on reports that undocumented materials may be buried in this area. It may be advantageous to perform a nondestructive survey (such as by Ground Penetrating Radar) to determine whether or not there are unknown materials beneath the surface. It is very likely that the results of such a survey would result in a lower score for the site. Recent observation (early 1986) of mercury contamination at this area (near the old HTRE-3 motor) indicates a possible spill, and justifies soil sampling to verify the presence and extent of mercury contamination. Characterization for mercury contamination should include approximately one mile of railroad tracks over which the HTRE-3 assembly was transported.

The TSF Disposal Pond (TAN-736) scored above 10.5 and appears to warrant some additional study. The contaminants that pose the largest threat of migration are chromium, lead, and mercury and are only suspected to be present. It is recommended that a sampling survey be taken on the pond sediments to determine whether hazardous materials are present in significant quantities. The groundwater monitoring recommendations made for the Injection Well also apply to this site.

The known mercury spill outside TAN-607 scored 9.5. An unknown quantity of mercury remained after clean up of this spill that occurred in the 1960's. Sampling of the spill area, including the TAN Hot Shop is considered appropriate to verify the presence or absence of contamination. Only small quantities of hazardous waste are thought to have been dispersed at the TSF Burn Pit (Score 5.8), which discontinued operation in 1958. However, surface soil or core samples are appropriate to confirm the absence of any persistent hazardous compounds.

6.3 TAN/Loss-of-Fluid-Test (TAN/LOFT) Facility

Neither of the two scored sites at LOFT is recommended for additional study; both scored below 7.5. The two sites involved are the LOFT Diesel Fuel Spills at TAN-629 and the LOFT Disposal Pond (TAN-750).

6.4 TAN/Initial Engine Test (IET) Facility

Three sites at IET were scored. Two of these the Hot-Waste Tank and the Septic Tank received scores of 2.4 and 0, respectively, and are recommended to be deleted from additional study. The third site (the Injection Well) received a score of 9.5. Available records of operating procedures indicate that the only hazardous wastes (corrosives) going to this well were at least partially preneutralized. The score was based on the conservative estimate that the wastewater may have been corrosive when injected. Even under this conservative assumption, there would be no hazardous characteristics remaining from these past operations due to the high groundwater volumes and flow in the aquifer. To verify this, efforts will be made to directly sample and characterize groundwater from this well, or from downgradient USGS monitoring wells.

6.5 TAN/Water Reactor Research Test Facility (WRRTF)

Two of the five sites at WRRTF are recommended for no further action. These sites are the Two-Phase Pond (Score 6.3), and the Radioactive Liquid Waste Tank (Score 4.6). As with the IET Injection Well, the WRRTF Injection Well (Score 14.5) is suspected of receiving only corrosive wastewater. Descriptions of past operations indicate these wastes were neutralized before discharge. The site probably should not have been scored. In either case, it is safe to say that, due to the high flows in the aquifer, no hazardous constituents remain from these past operations. Radioactive contamination suspected of going to this well was very minor and was from a one-time incident. This well was plugged with concrete and capped in 1984, preventing any direct groundwater sampling. Existing USGS monitoring wells will, however, be evaluated as to their ability to detect contamination from this area.

The WRRTF Burn Pit and Evaporation Pond received scores of 6.8 and 5.3, respectively. It is thought that waste oils and non-chlorinated solvents were the only hazardous constituents disposed in the Burn Pit, and surface soil sampling may be appropriate to verify the absence of persistent contaminants at this site. Similarly, although dilute corrosive wastes may represent the only hazardous constituents discharge to the Evaporation Pond, sediment and core sampling can be conducted to confirm the absence of hazardous leachable compounds.

6.6 Auxiliary Reactor Area (ARA)

Six sites at the ARA were scored. It is recommended that the SL-1 Burial Ground at ARA II (Score 13.7) and the ARA III Sanitary Sewer Leach Field (ARA-740; Score 10.0) be eliminated from further study. The SL-1 Burial Ground was scored for radioactivity only. Steps have already been taken to stabilize the site and monitoring for migration of radionuclides is accomplished routinely. It is proposed that the existing disposal method is adequate, unless it becomes apparent, at some time in the future, that another technique is significantly better and would not unduly expose personnel during its implementation. No further study is recommended on the ARA III Sanitary Sewer Leach Field because it is to be closed under RCRA regulations.

The ARA I Chemical Leach Field (ARA-745) scored 5.3, and is suspected primarily of receiving small quantities of hazardous wastes from laboratory operations. Despite the relatively low score, sampling of water and sediments is considered appropriate to identify any unknown hazardous discharges or persistent contaminants.

The ARA I Sanitary Waste Leach Field, and ARA-I Pad (near ARA-627) scored 1.6 and 0.3, respectively, due to radioactivity contamination potentially resulting from cleanup of SL-1. Surface soil sampling of these areas is recommended to better characterize the radioactivity levels: sampling for chemical constituents is not considered necessary, as there is no evidence of any chemical waste disposal activities or spills at these areas.

The remaining site at ARA, not yet addressed, is the ARA III Radioactive-Waste Leach Field (Score 10.5). Contrary to the name, the site received its higher score due to chemical contamination. It is suspected that chromate-contaminated cooling water may have reached this field. A soil-sampling survey appears appropriate to determine if significant contamination is present. At a minimum, the samples should be analyzed for chromium and some general indicator parameters.

6.7 Power Burst Facility (PBF) Area

Seven sites in the PBF area were scored. The lined PBF Evaporation Pond (Score 4.0) will be closed under RCRA regulations.

The highest scoring site in the PBF area is the PBF Corrosive-Waste Injection Well (Score 12.0). Chrome and corrosives are suspected of going to this well. Since the well injected wastewater at a depth of 35 m (115 ft) and its use has already been stopped, there is little else that can be done on the surface to prevent migration. Even though the potential for serious environmental impact appears small, it may be appropriate to include analysis for hazardous waste parameters (particularly chromium) in the existing groundwater monitoring in the area. It is also recommended that the locations of existing monitoring wells be evaluated as to their ability to detect contamination from the PBF area.

Similarly, existing wells will be evaluated for their ability to detect contamination from the PBF Warm Waste Injection Well (Score 4.2). This well was capped and sealed in 1984, and is suspected of reviewing radioactive wastes only.

The SPERT I Corrssive Waste Seepage Pit, and SPERT II, III, and IV Leach Ponds received similar scores (6.0, 4.5, 5.0 and 5.0, respectively). In each case, soil neutralization of past corrosive discharges is expected to have occured. Soil/sediment samples from these locations should be taken, however, to verify the absence of leachable and/or persistent contaminants.

6.8 Experimental Organic Cooled Reactor (EOCR)

The only site (EOCR Leach Pond) within the EOCR facility was identified and received a score of 7.1. Although soil neutralization of corrosives discharged to this pit is expected, sediment sampling is recommended to verify the absence of other contaminants.

6.9 Organic Moderated Reactor Experiment (OMRE)

The only site identified at the OMRE facility is the OMRE Leach Pond. It received a score of 7.8, due to radioactive contamination (the score for chemical contamination was 7.1). The radioactive waste characterization element of the score was estimated at values felt to be conservatively high. The D&D effort has already been accomplished and some remedial action has, therefore, been done on sites with significant radioactive contamination. In this instance the old pond has been covered with clean soil to eliminate surface exposure, and the site is routinely monitored to ensure the surface remains acceptably clean. Considering the capacity of the soil column to attenuate the migration of radionuclides, this site does not appear to warrant additional remedial action or study under Phase II of the CERCLA effort.

6.10 Boiling Water Reactor (BORAX) Area

Sites within this area, the BORAX II-V Leach Pond and the BORAX I Burial Site received scores of 3.8 (HRS) and 2.5 (MHRS), respectively. Decommission and decontamination of the BORAX I Burial Site has already been accomplished, and is not recommended for further study. Discharge of corrosives and low-level radioactive wastewater to the Leach Pond was discontinued in 1964, and it is expected that soil attenuation, neutralization and natural decay have limited the presence and migration of hazardous contaminants. Nevertheless, characterization of pond sediments is recommended to determine the presence or absence of persistent leachable contaminants.

6.11 Experimental Breeder Reactor-I (EBR-I)

There were no sites identified in this area.

6.12 Zero Power Reactor-III (ZPR-III)

There were no sites identified in this area.

6.13 Liquid Corrosive Chemical Disposal Area (LCCDA)

The LCCDA received a score of 3.5. Although it is unlikely that waste could ever have migrated from this site without losing its corrosive characteristics, soil sampling of the area is recommended to verify the absence of other persistent hazardous constituents.

6.14 Munitions/Ordnance Areas

The NODA received a score of 5.9 for its past use as a hazardous waste storage area, and additional study may be appropriate. If more toxic and persistent chemicals were spilled than were considered in the scoring effort, the score would be raised. To verify whether or not this is the case, a more detailed sampling survey of the area where waste was stored is recommended. Since a wide variety of wastes may have been stored, a wide variety of parameters should be included in the analytical work. Appropriate indicator parameters may be substituted for individual species.

The areas suspected of containing munitions/ordnance that were described in Section 4.14 were not scored. These areas do not represent a significant potential for contaminant migration and hence are out of the scope of the CERCLA program. These areas do, however, present a safety hazard to people involved in present and future use of the INEL. Therefore, it is recommended that DOE pursue the possibility of having DOD accept the responsibility of dealing with these areas, and that a small amount of funding be set aside annually to allow INEL personnel to do detailed surveys and clear, if possible, small areas at a time.

6.15 Central Facilities Area (CFA)

Five sites within CFA were identified and scored; all five received scores greater than 7.5. Three of the sites, however, will be addressed and closed under RCRA regulations, since they received hazardous waste after November 19, 1980. These three sites are the CFA Landfill, the Motor Pool Pond, and the CF-633 French Drain.

It is recommended that the two remaining sites be surveyed to verify the presence of hazardous constituents and, if possible, the extent of any migration. The CF-674 Pond is suspected of receiving moderate quantities of various hazardous constituents. A sampling survey of the old pond sediments should include measurements for metals, particularly mercury, and organic indicators to verify that no solvents went to the pond. The last site, the CFA Sewage Drain Field, was scored for radioactive contamination only and scored just over 7.5. It is assumed that this field will continue to receive radioactively contaminated wastewater from the laundry, but it would be appropriate to determine the extent of migration from past operations so that future operations may be better evaluated. It is proposed that this be done by taking auger samples from various locations (at depths below the discharge lines) within the drainage field area and analyzing the samples for radionuclide contamination.

6.16 Radioactive Waste Management Complex (RWMC)

The RWMC has an extensive monitoring program already in place, as described in Section 4.16; surface as well as subsurface monitoring is done. Although radionuclides, rather than other hazardous materials, have been the parameters of primary interest, it is likely that they would act as an excellent tracer for migration of any other hazardous substance. No significant migration from the RWMC has been documented to date, but there is some question as to whether existing subsurface monitoring locations are adequate to detect any such migration should it occur. It is recommended that the single well now used to monitor the cyclic perched water table be augmented with additional wells. The perched tables observed at depths of about 34 m (110 ft) and 73 m (240 ft) should both be monitored, upgradient and downgradient if possible. The existing aquifer monitoring wells should also be evaluated as to their ability to intercept any contaminant migration. Parameters covered in the monitoring effort should be increased to include, at a minimum, the parameters required to meet interim groundwater monitoring requirements as described in 40 CFR Part 265.

APPENDIX A

Professional Qualifications of Installation Assessment Team

Keith D. Davis, P. E.

M. S. Civil and Environmental Engineering,
Utah State University

B. S. Civil Engineering

Relevant Experience

- Senior Program Specialist, Hazardous Waste Program, EG&G Idaho, Inc.

    - Prepared RCRA Permit, Part B for INEL

- Environmental/Sanitary Engineer, Hill Air Force Base.

    - Environmental Assessment/Impact Statements

    - Engineer Manager for Industrial Waste Treatment Plant

    - Hazardous Waste Management--Part A and Part B Permits

    - Base Installation Restoration Program to identify, evaluate and correct hazardous waste disposal activities

    - Ensure Base compliance with local, state, and federal environmental regulations

K. L. Falconer

M. S. Water Resources Management and Water Chemistry, University of Wisconsin

B. A. Botany and Chemistry, University of Montana

Relevant Experience

Seven years experience in hazardous materials management, covering a variety of research and regulatory areas. Includes environmental risk assessment, hazardous waste management, low-level radioactive waste management, and occupational health. Expertise in the areas of chemistry, hydrology, and engineering. Work has included publications in the areas of hazardous material, risk analysis, contaminant migration, and disposal site selections.

Phyllis S. Fridlund

B. S. Chemical Engineering, University of New Mexico

B. A. Communications/Public Relations, Washington State University

Relevant Experience

- EG&G Idaho, Inc.

  - Work in areas of cost analysis, software validation, and technical writing (including "FAST Goes Underground," presented at Seventh Annual International Conference for International Society of Parametric Analysts).

  - Technical writing included developing a working understanding of the subject followed by detailed written documentation or analysis.

Donald M. LaRue

M. S. Chemical Engineering, Brigham Young University

B. E. S. Brigham Young University

Relevant Experience

- Project Manager--U.S. Department of Energy.

  - Manager of research projects in separation sciences

  - Member of project team responsible for design, construction, and operations of an underground coal gasification project. Responsible for groundwater sections of permit applications.

- Chemical Engineer--Laramie Energy Research Center, U.S. Department of Energy Research.

  - Responsible for laboratory studies on high-pressure hydro-retorting of western and Devonian shales and on the use of spent-oil shales for H_2S scrubbing. Served as DOE's technical monitor on an experiment refiving shale oil.

- Research Engineer--Dow Chemical Company

  - Responsible for research into removal of particulate and asphaltene residue form coal liquefaction production, and for subsequent utilization of the residue.

Douglas Nishimoto

M. S. Chemical Engineering, Colorado School of Mines

B. A. Chemistry, Colorado College

Relevant Experience

EG&G Idaho, Inc., Hazardous Waste Program

- Attendance at the following conferences/short courses:
  - EPA 11th Annual Research Symposium: Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste.
  - Lion Technology's compliance management course on EPA and DOT regulations applicable to disposal of hazardous wastes.
- Contributor to the following reports/papers:
  - Hazardous Waste Program Annual Report
  - Department of Energy Idaho National Engineering Laboratory Candidate Radioactive Mixed Waste Streams
  - Options for Treatment, Storage, and/or Disposal of Radioactive Mixed Waste at the Idaho National Engineering Laboratory
  - EG&G Hazardous Radioactive Mixed, and Special Hazardous Waste Streams
  - Radioactive Mixed Waste Options Study

Marie L. Saint-Louis

B. S. Chemical, Engineering, Polytechnic Institute of New York

Relevant Experience

Six months with EG&G's Mechanical Engineering North facility and with the Hazardous Waste Program of the Waste Management Department.

Richard C. Green

Explosive Safety Engineer,
Safety and Environmental Programs

Relevant Experience

- Explosive ordnance/munition disposal
- Investigations of past DOD activities on the INEL
- Physical inspections of INEL sites where ordnance/munitions have been found

APPENDIX B

TABLE B-1

Master List of Facilities of Concern

TABLE B-1. MASTER LIST OF FACILITIES OF CONCERN

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes (1)	Past On-Site T/S/D (2)
Test Reactor Area (TRA)					
MTR Reactor	603 '52 - '70	(3)	X	X	Pond (TRA-758) Injection Well
Test Assemblies	603 '52 - '70	(3)	X	X	Pond (TRA-758) Injection Well
Chemical Labs	604 '52 - P	(3)	X	X	Pond (TRA-758) and ICPP
Craft Shops - Carpentry and Paint	606 '57 - P	(3)	X	X	Dumped
Demineralization Plant	608 '52 - P	(3)	X	X	Ponds (TRA-758 and 701)
Steam Plant	609 '52 - P	(3)	X	0	
Metallurgy Lab	614 '52 - '70	(3)	0	0	
Electrical Shop Area	614 '75 - P	(3)	0	0	
Vehicle Garage	614 '84 - P	(3)	0	0	
Cafeteria	616 '52 - P	(3)	0	0	
Nuclear Mterials Inspection	621 '82 - P	(3)	0	0	
Sewage Treatment Building	624 '52 - P	(3)		0	
Craft Shop - Electrical heavy equipment, welders and filters	625 '81 - P	(3)	X	0	

(1) Hazardous waste according to RCRA or a potentially hazardous waste.

(2) Past treatment, storage, and/or disposal activities.

(3) None recorded.

(4) Radioactive only.

X: Yes
N: No

TABLE B-1. (continued)

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes (1)	Past On-Site T/S/D (2)
Fuel Oil Pumphouse	627 '52 - P	(3)	X	O	
Gas Cylinder Storage	629 '56 - P	(3)	O	O	
Acid Pumphouse	631 '52 - P	(3)	X		
Hot Cells	632 '52 - P	(3)	X	X	ICPP
Support Testing - WINCO (Gamma Bldg)	641 '55 - P	(3)	X	O	
ETR Reactor Building	642 '57 - '82	(3)	X	X	Pond (TRA-758) and Injection Well
Sample Laboratory	643 '66	(3)	X	O	
ETR Secondary Pumphouse Chemical Systems	645 '57	(3)	X	X	Pond (TRA-758) and Injection Well
ETR Electrical Building Battery Room	648 '57 - '82	(3)	O	O	
Craft Shops - Machine, Weld, Pipefitters	653 '57 - P	(3)	X	O	
Applied Physics Lab	654 '59 - '82	(3)	O	O	
Reactivity Measurement Facility	660 '59 - P	(3)	O	O	
Alpha Labs (Part of Chem. Lab)	661 '62 - P	(3)	X	X	Pond (TRA-758) and ICPP
Flammable Liquid Storage	662 '61 - P	(3)	X	O	

(1) Hazardous waste according to RCRA or a potentially hazardous waste.

(2) Past treatment, storage, and/or disposal activities.

(3) None recorded.

(4) Radioactive only.

X: Yes
N: No

TABLE B-1. (continued)

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes (1)	Past On-Site T/S/D (2)
Temporary Lab	665 '62 - '70	(3)	O	O	
Hydraulic Test Lab	666 '63 - P	(3)	O	O	
Health and Safety - Medical Dispensary and Lab	667 '64 - P	(3)	O	O	
Instrument and Physics Labs	668 '56 - P	(3)	O	O	
ATR Reactor Building	670 '64 - P	(3)	X	O	
ATR Secondary Pumphouse	671 '71 - P	(3)	X	O	
ETR Cooling Tower	751 '57 - '82	(3)	O	O	
ATR Cooling Tower	771 '64 - P	(3)	O	O	
Test Area North (TAN)/Technical Support Facility (TSF)					
Steam Plant	603 '56 - P	(3)	X	O	
Maintenance Shop	604 '56 - P	(3)	X	X	
Nondestructive Engineering Lab	606 '56 - P	(3)	O	O	
Pipe Laundry & Chemical Cleaning		607 '55 - '84	(3)	X	X TSF well and pond
Decontamination Room	607 '55 - '84	(3)	X	X	TSF Warm-Waste Disposal System
Sandblasting Room	607 '55 - '84	(3)	X	X	RWMC

(1) Hazardous waste according to RCRA or a potentially hazardous waste.

(2) Past treatment, storage, and/or disposal activities.

(3) None recorded.

(4) Radioactive only.

X: Yes
N: No

TABLE B-1. (continued)

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes (1)	Past On-Site T/S/D (2)
Weld Shops	607 '55 - P	(3)	X	O	
Machine Shops (North and South)	607 '55 - P	(3)	O	O	
Valve Shops (East and West)	607 '55 - P	(3)	O	O	
Electric Shop	607 '55 - P	(3)	X	O	
TAN Hot Cell	607 '55 - P	(3)	X	X	TSF Warm-Waste Disposal System
Hot Shop	607 '55 - P	(3)	(4)	(4)	TSF Warm-Waste Disposal System
Photo Lab	607 '55 - P	(3)	X	X	Injection Well and Disposal Pond
Mechanics Shop	609 '83 - P	604 '56 - '82	X	X	Roads and Oil Recycler
Fuel Pump House	611 '56 - P	(3)	X	O	
Sewage Treatment Plant	623 '56 - P	(3)	O	O	
Hot Cell Annex	633 '58 - P	(3)	X	X	TSF Warm-Waste Disposal System
Carpentry and Paint Shop	636 '67 - P	(3)	X	O	
Water Filtration Bldg (Chemistry Control)	649 '60 - P	(3)	X	(4)	
Gas Cyliner and Oil Drum Storage	662 '78 - P	(3)	X	O	

(1) Hazardous waste according to RCRA or a potentially hazardous waste.

(2) Past treatment, storage, and/or disposal activities.

(3) None recorded.

(4) Radioactive only.

X: Yes
N: No

TABLE B-1. (continued)

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes (1)	Past On-Site T/S/D (2)
Service Station	664 '54 - P	(3)	X	O	
Chlorine Treatment bldg	670 '54 - P	(3)	X	O	
TAN/Loss-of-Fluid Test (LOFT) Facility					
Craft Workshop	624 '56 - P	(3)	X	O	
Craft Shop	T-25	(3)	X	O	
Boiler Plant	630	(3)	O	O	
Chemical Laboratory	630	(3)	X	X	LOFT Pond
Demineralization Plant	630	(3)	X	X	
Reactor Containment Bldg.	650	(3)	X	(4)	LOFT Pond
Liquid-Waste Storage Tank Building	726 '75 - P	(3)	(4)	(4)	TAN/TSF Pond
Septic Tank	736 '58 - P		O	O	
TAN/Initial Engine Test (IET) Facility					
Fuel Transfer Pump Bldg	625 '56 - P	(3)	X	O	
Tank Building	627 '56 - P	(3)	X	X	IET Injection Well
Septic Tank	710 '56 - P	(3)	O	O	

(1) Hazardous waste according to RCRA or a potentially hazardous waste.

(2) Past treatment, storage, and/or disposal activities.

(3) None recorded.

(4) Radioactive only.

X: Yes
N: No

TABLE B-1. (continued)

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes (1)	Past On-Site T/S/D (2)
TAN/Water Reactor Research Test Facility (WRRTF)					
Shielded Cells	640 '58 - P	(3)	X	(4)	Liquid Rad. Waste Disposal System
Utility Boilers	641 '58 - P	(3)	O	O	
Demineralizer	641 '58 - P	(3)	X	X	Neutralized prior to discharge
Laboratory	645 '60 - P	(3)	O	O	
Pool/Test Area	646 '65 - P	(3)	O	O	
Demineralizer	646 '58 - P	(3)	X	X	Neutralized prior to discharge

(1) Hazardous waste according to RCRA or a potentially hazardous waste.

(2) Past treatment, storage, and/or disposal activities.

(3) None recorded.

(4) Radioactive only.

X: Yes
N: No

TABLE B-1. (continued)

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes (1)	Past On-Site T/S/D (2)
Central Facilities Area (CFA)					
Warehouse - Chemical Storage	601 '50 - P	(3)	X	0	
Dispensary - Laboratory	603 '81 - P		0	0	
Safety Office - Laboratories	612			X	
Laundry	617 '81 - P	669 '50 - '81	(4)	(4)	CFA sewage treatment plant-drain field
Multicraft Shop	621 '83 - P	654 '50 - '83	X	0	
Multicraft Shop	622 '84 - P	654 '50 - '84	X	0	
Instrumentation and Chemical Laboratories	633 '50 - P	(3)	X	X	French drain east end of building
Heat Plant	650 '50 - P	(3)	X	0	
Meteorological Balloon Shelter	653 '60 - P	(3)	X	0	
Maintenance Shop - Paint Shop	654 '50 - P	(3)	X	X	CFA Landfill
Service Station - Steam Cleaner	664 '51 - P	(3)	X	X	Motor Pool Pond

(1) Hazardous waste according to RCRA or a potentially hazardous waste.

(2) Past treatment, storage, and/or disposal activities.

(3) None recorded.

(4) Radioactive only.

X: Yes
N: No

TABLE B-1. (continued)

Name	Present Location and Dates (Bldg. No.)	Past Location and Dates (Bldg. No.)	Handled Hazardous Materials	Generated Hazardous Wastes (1)	Past On-Site T/S/D (2)
Central Facilities Area (CFA)					
Equipment Repair Facility	665 '51 - P	(3)	X	X	CFA Landfill and Motor Pool Pond
Warehouse - Previous Location of Spent Fuel Processing Pilot Plant Operations	674 '53 - P	(3)	X	X	CF-674 Pond
Flammable Storage	684 '52 - P	(3)	X	O	
Technical Center	688/'52 - P 689	(3)	X	O	
Standards Calibration Lab	698 '69 - P	(3)	X	O	

(1) Hazardous waste according to RCRA or a potentially hazardous waste.

(2) Past treatment, storage, and/or disposal activities.

(3) None recorded.

(4) Radioactive only.

X: Yes
N: No

APPENDIX C

MUNITIONS/ORDNANCE PHOTOGRAPHS

(Section 4.14)

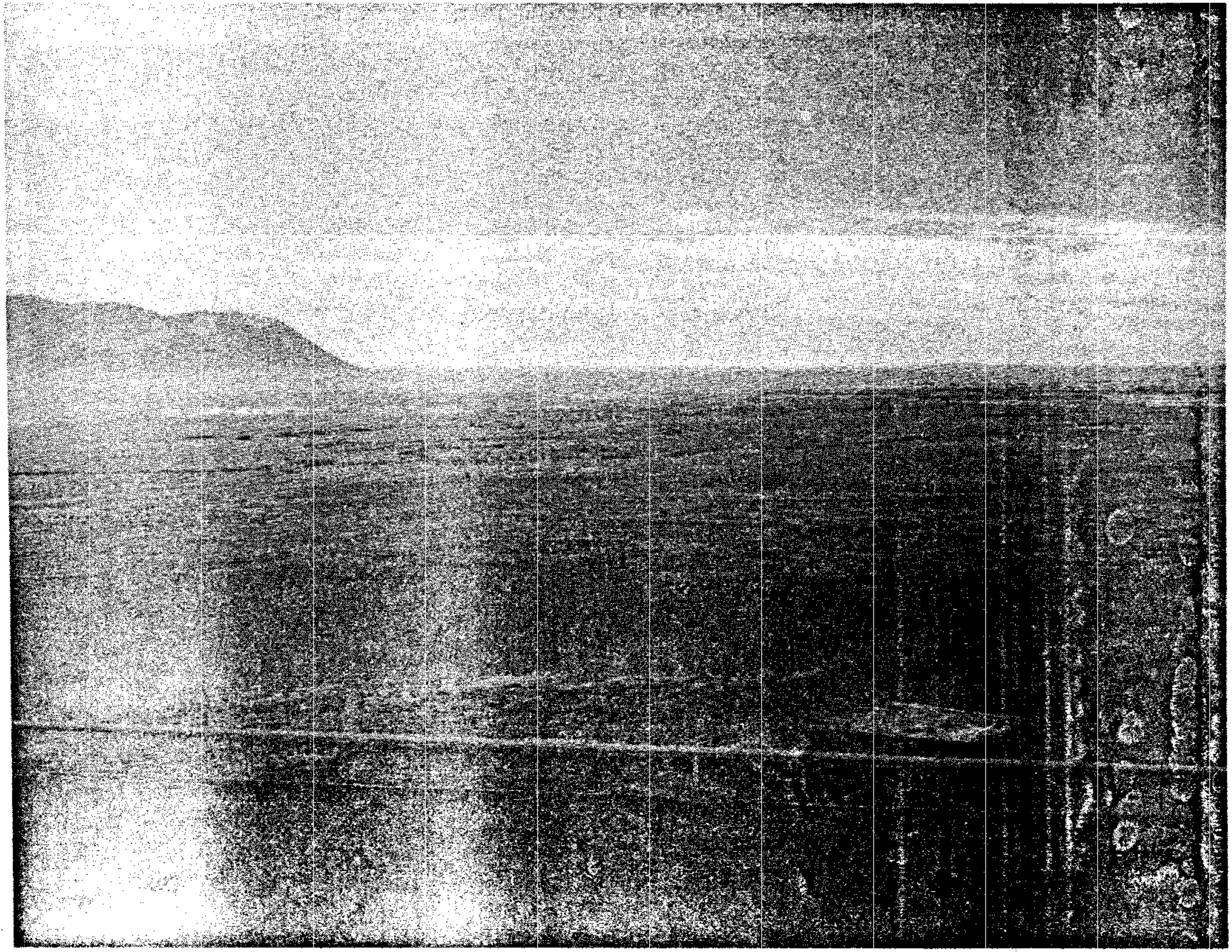

Figure C.1. Naval proving grounds aerial bombing range.

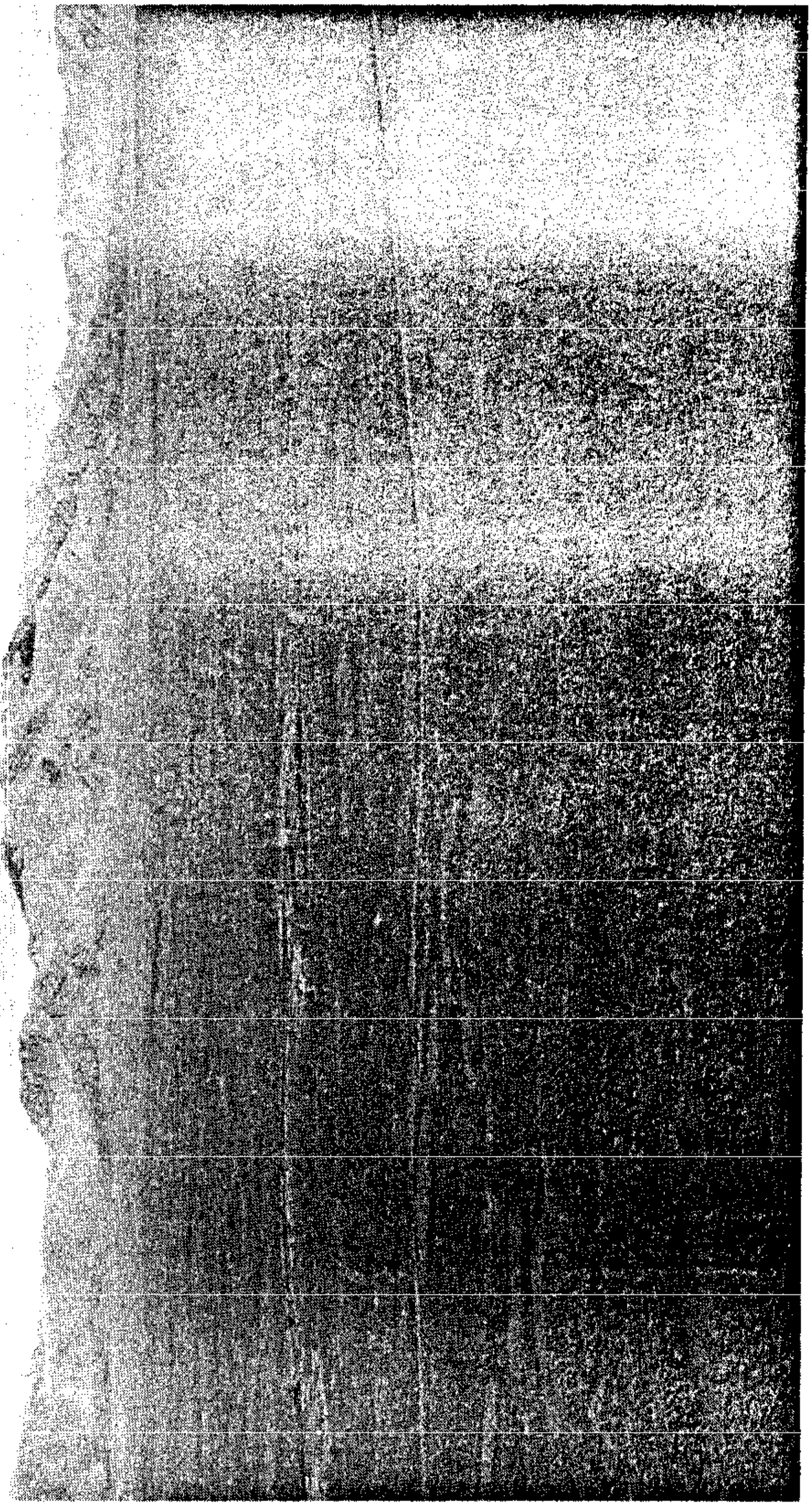

Figure C.2. Naval proving grounds aerial bombing range.

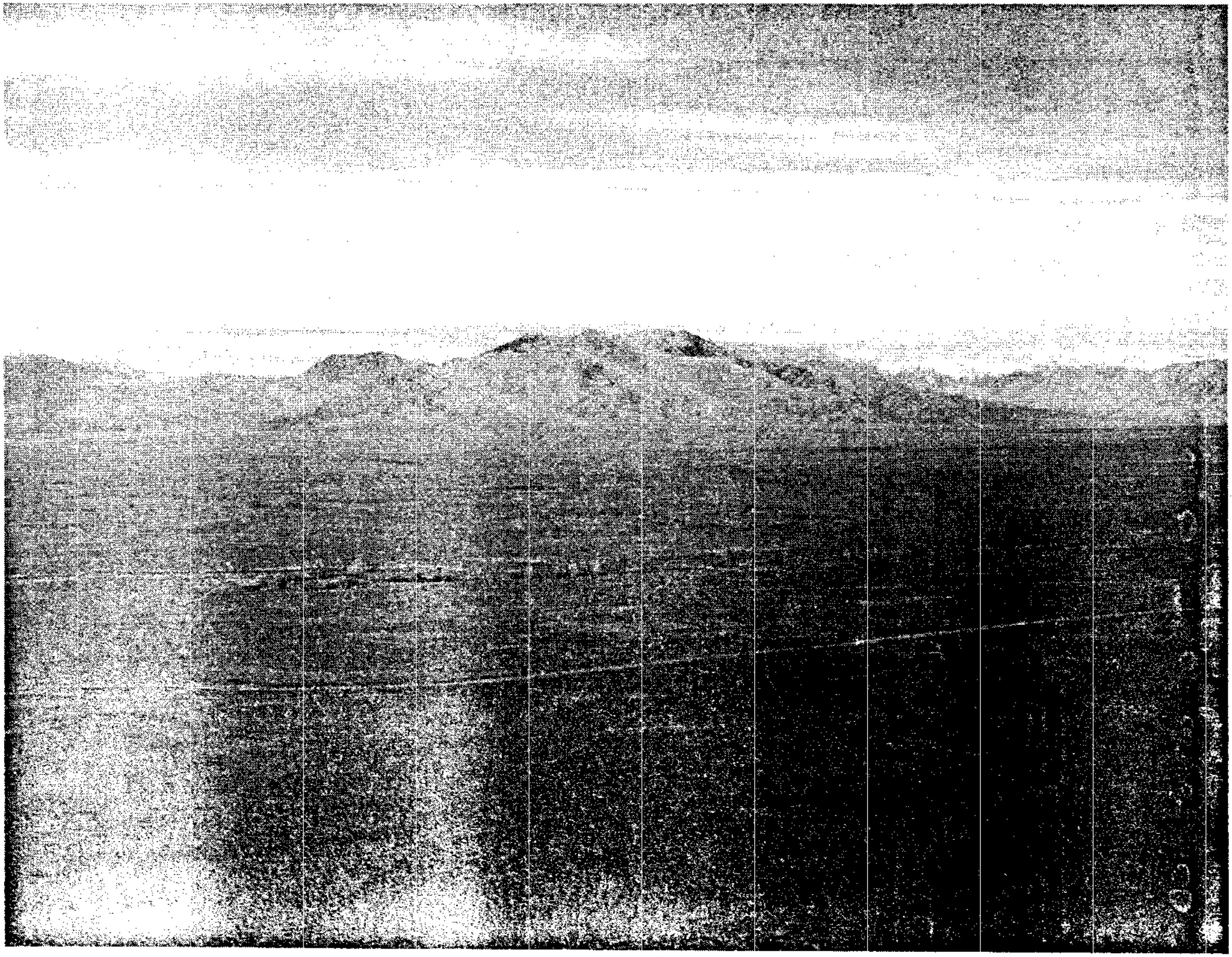

Figure C.3. Naval proving grounds aerial bombing range.

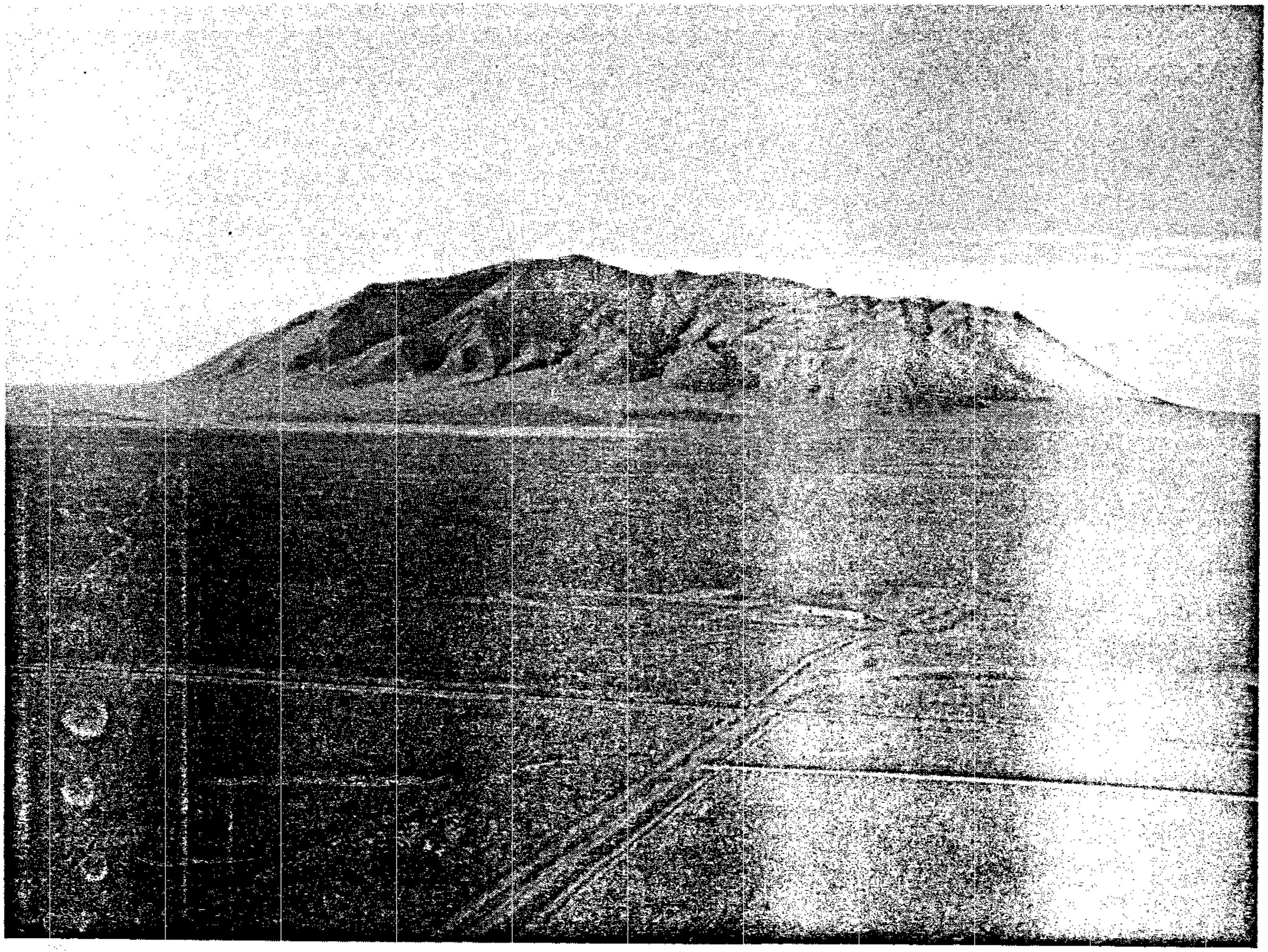

Figure C.4. Firing site for naval guns.

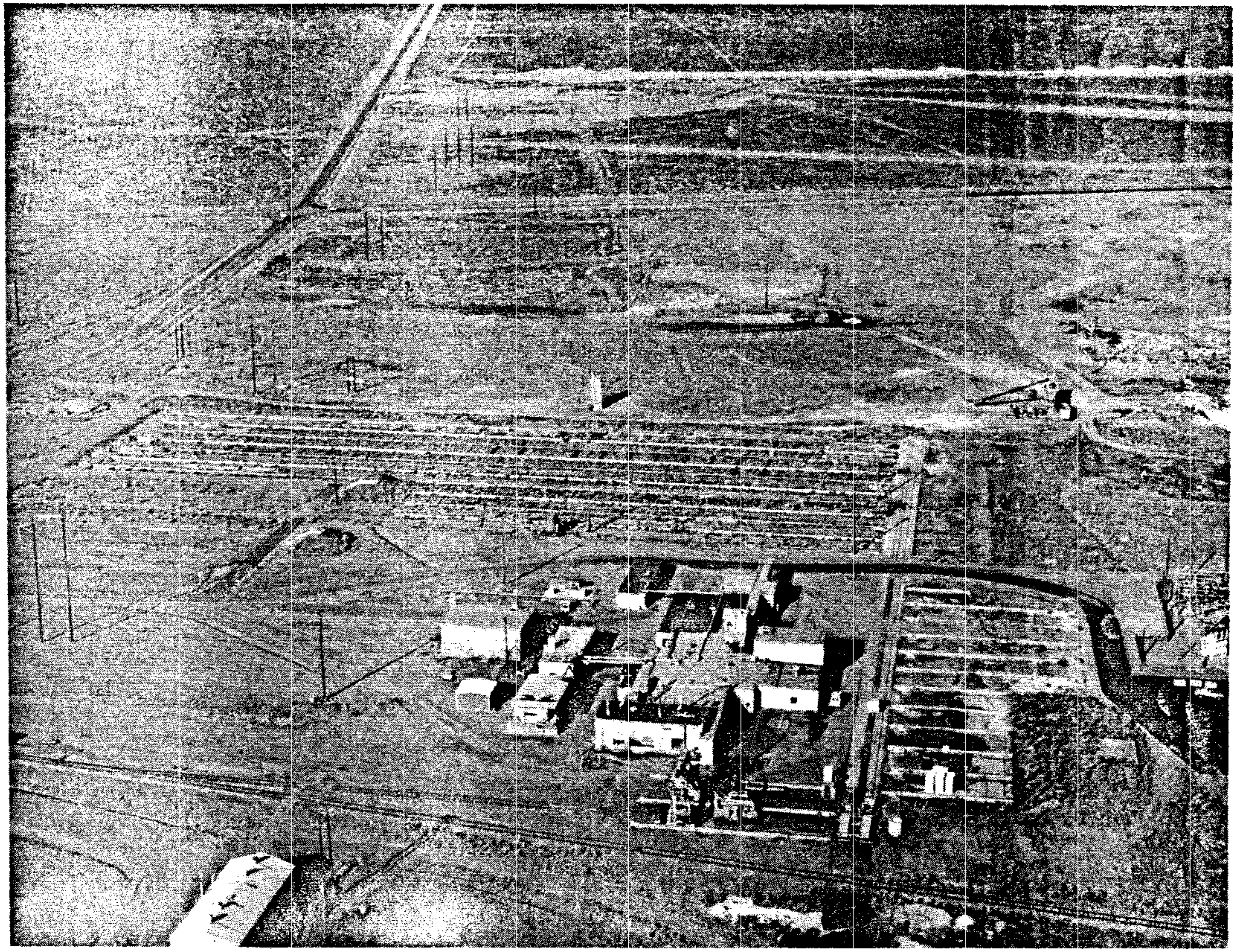

Figure C.5. CF 633 naval firing site.

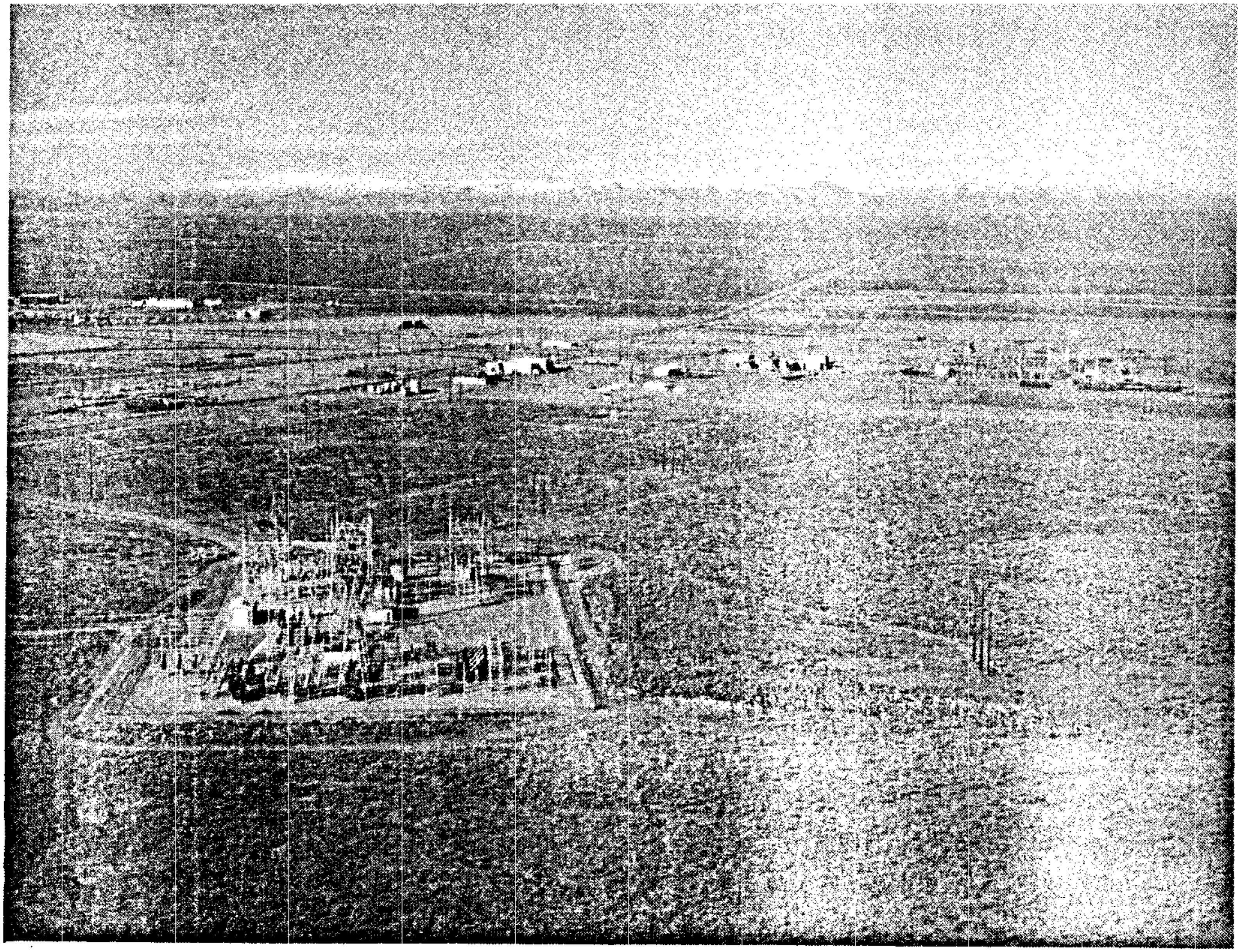

Figure C.6. CF 633 naval firing site.

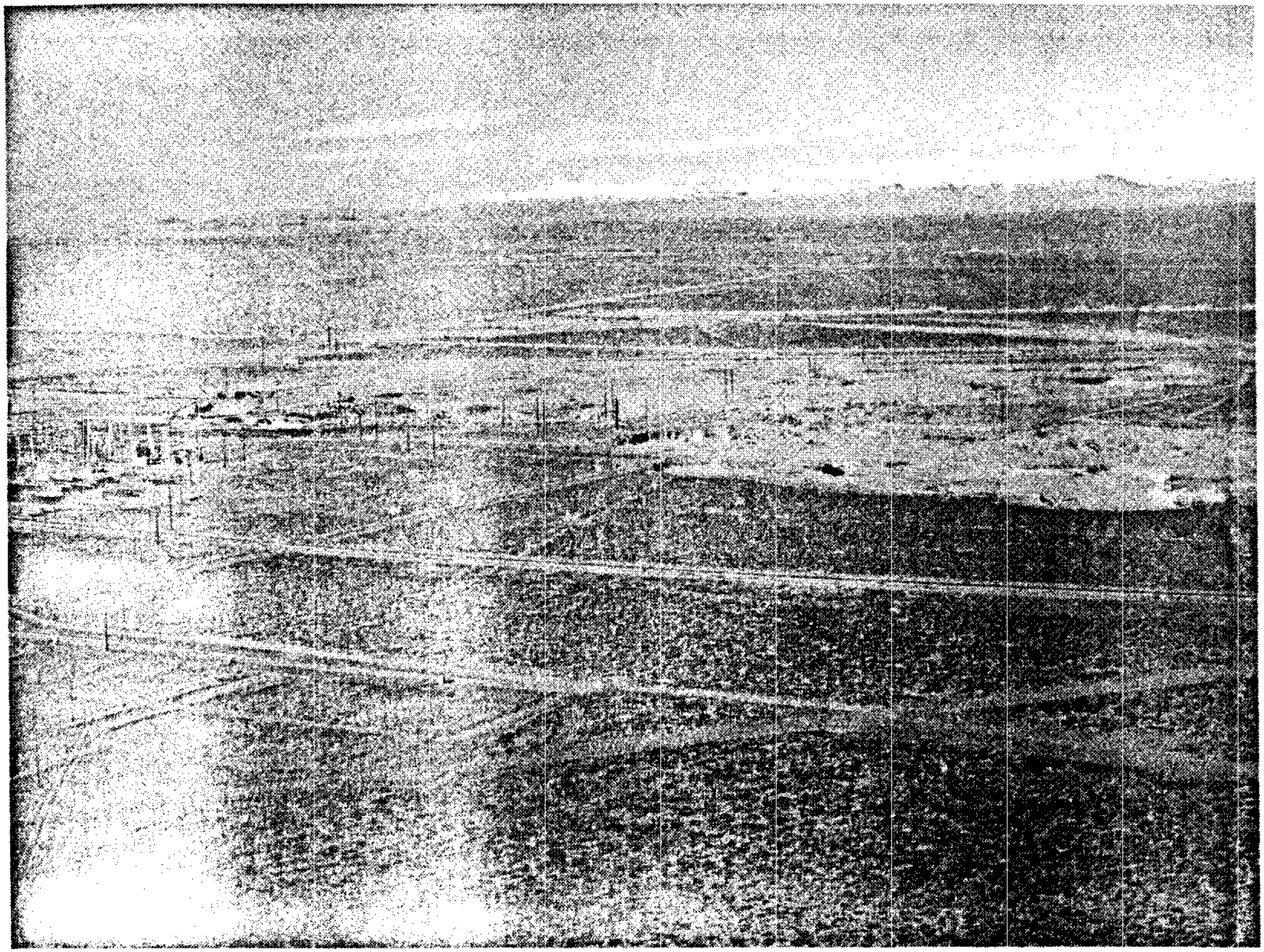

Figure C.7. Central Facilities gravel pit.

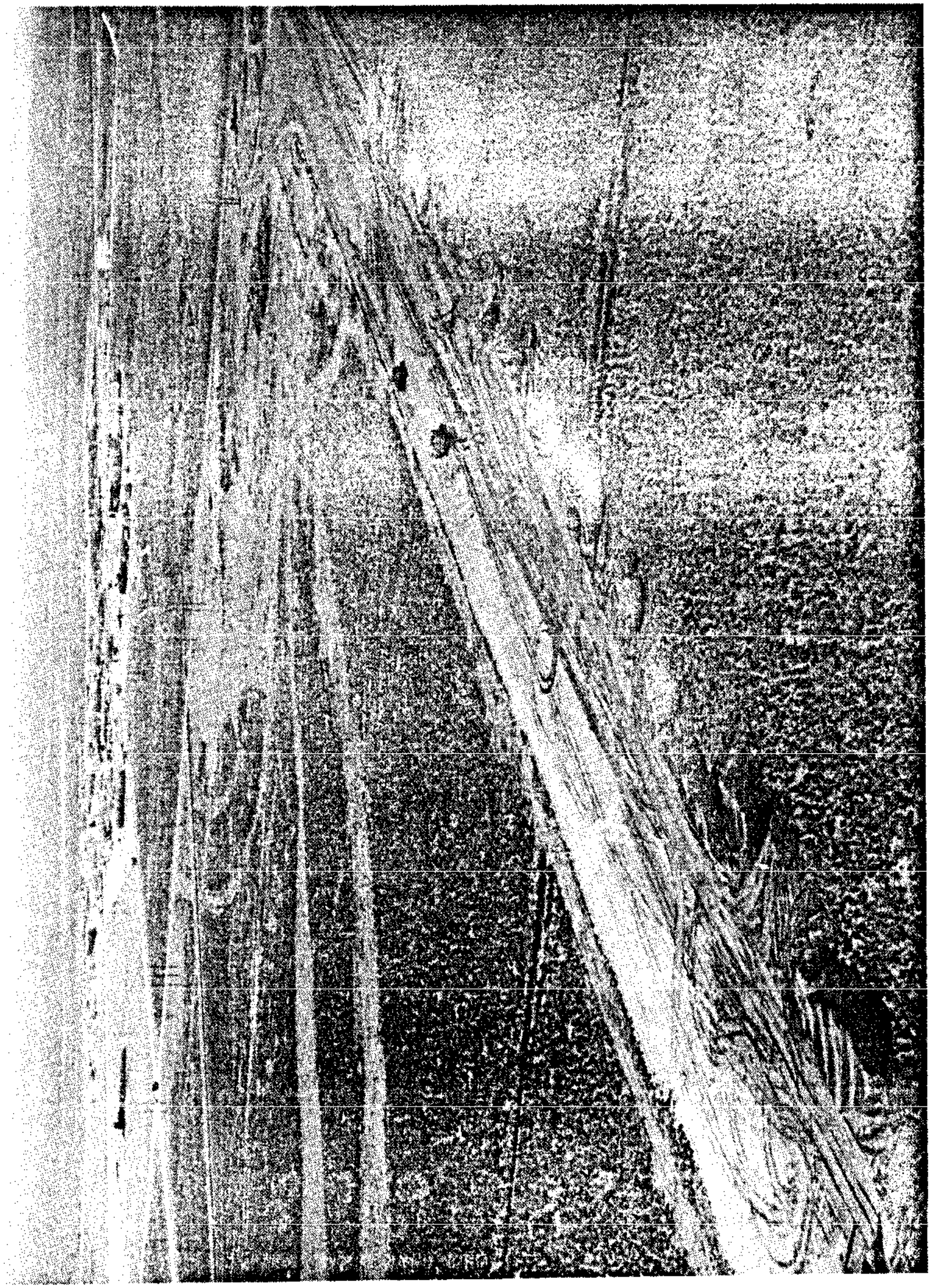

Figure C.8. Central Facilities sanitary landfill area.

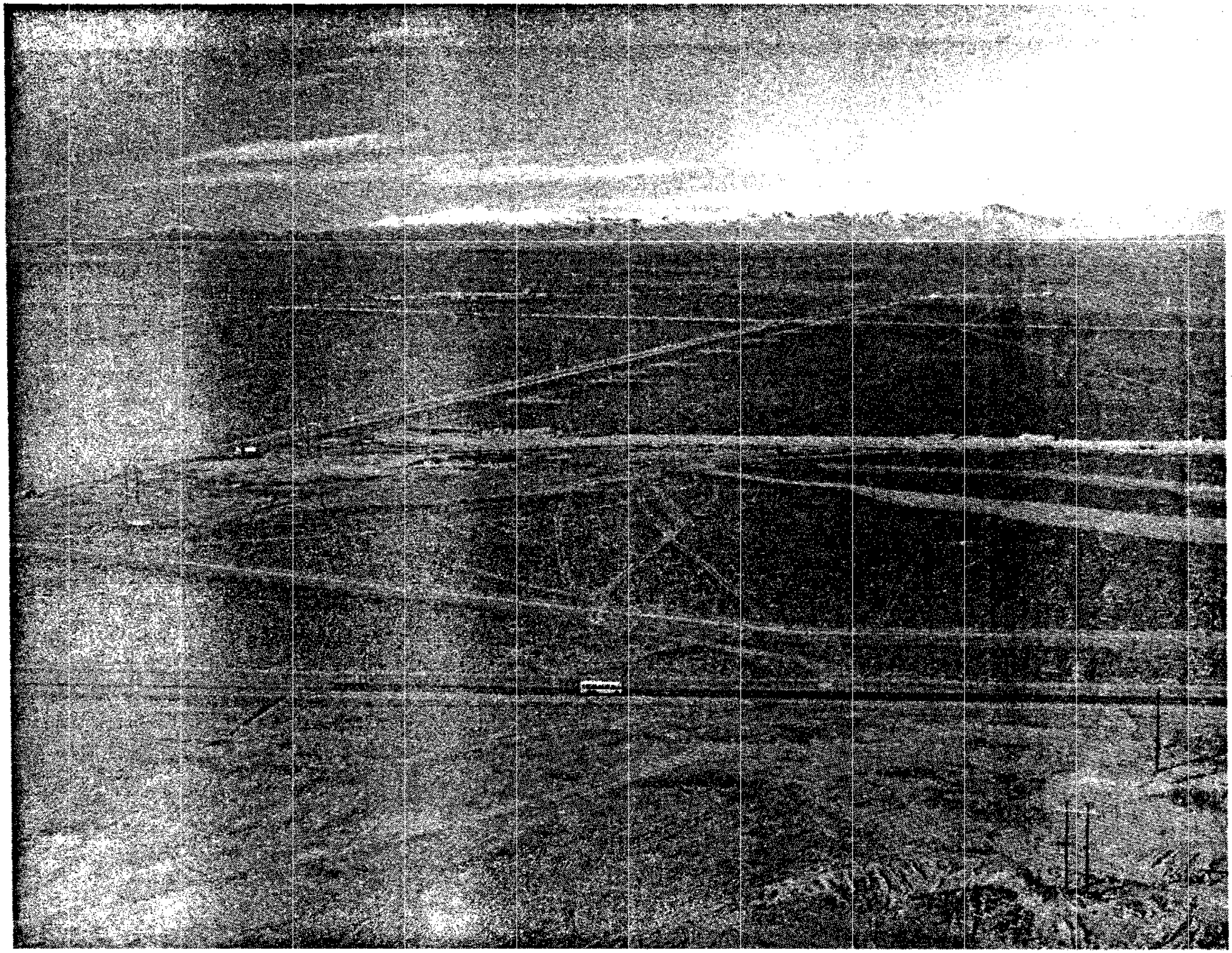

Figure C.9. Central Facilities sanitary landfill area.

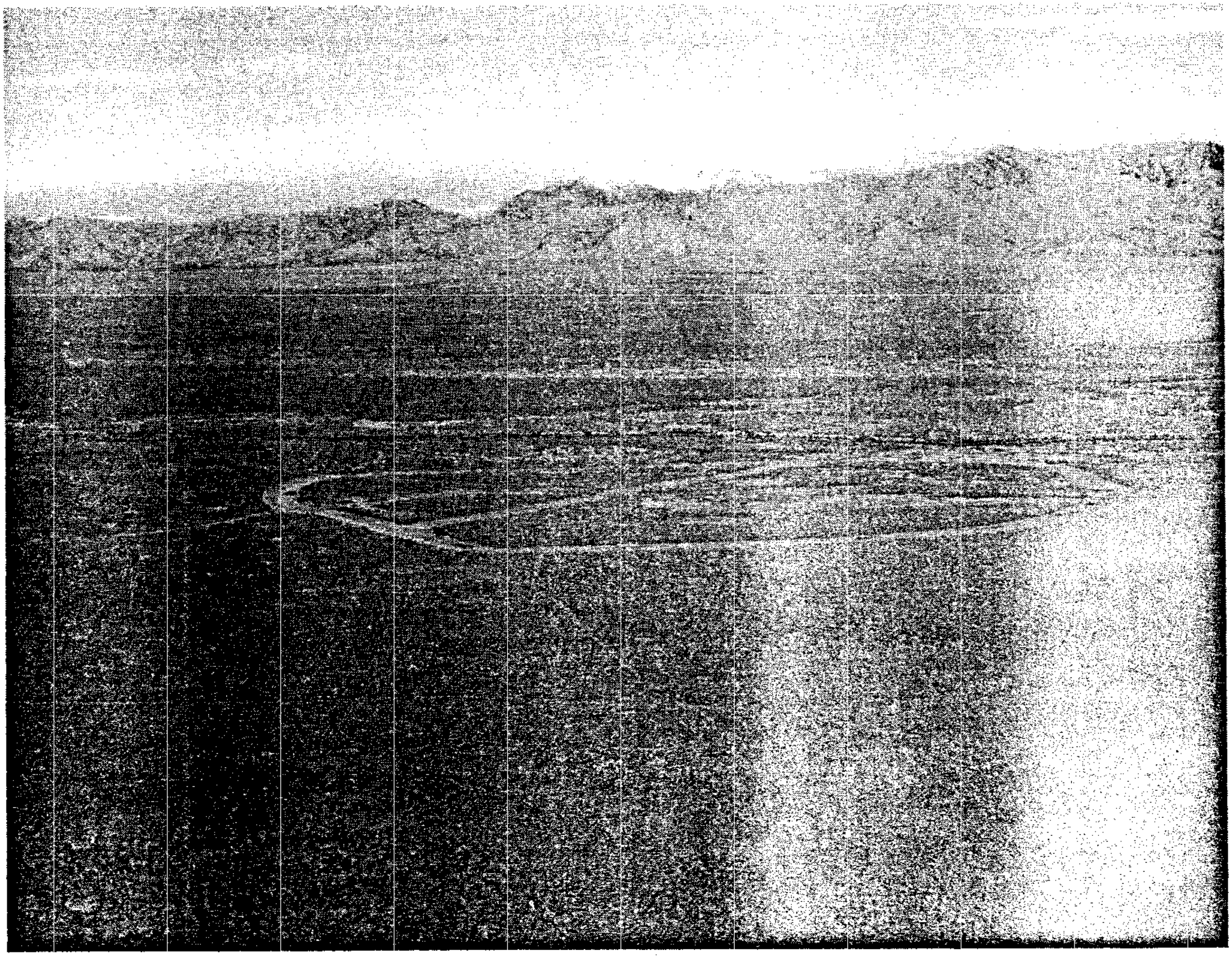

Figure C.10. Naval Ordnance Disposal Area.

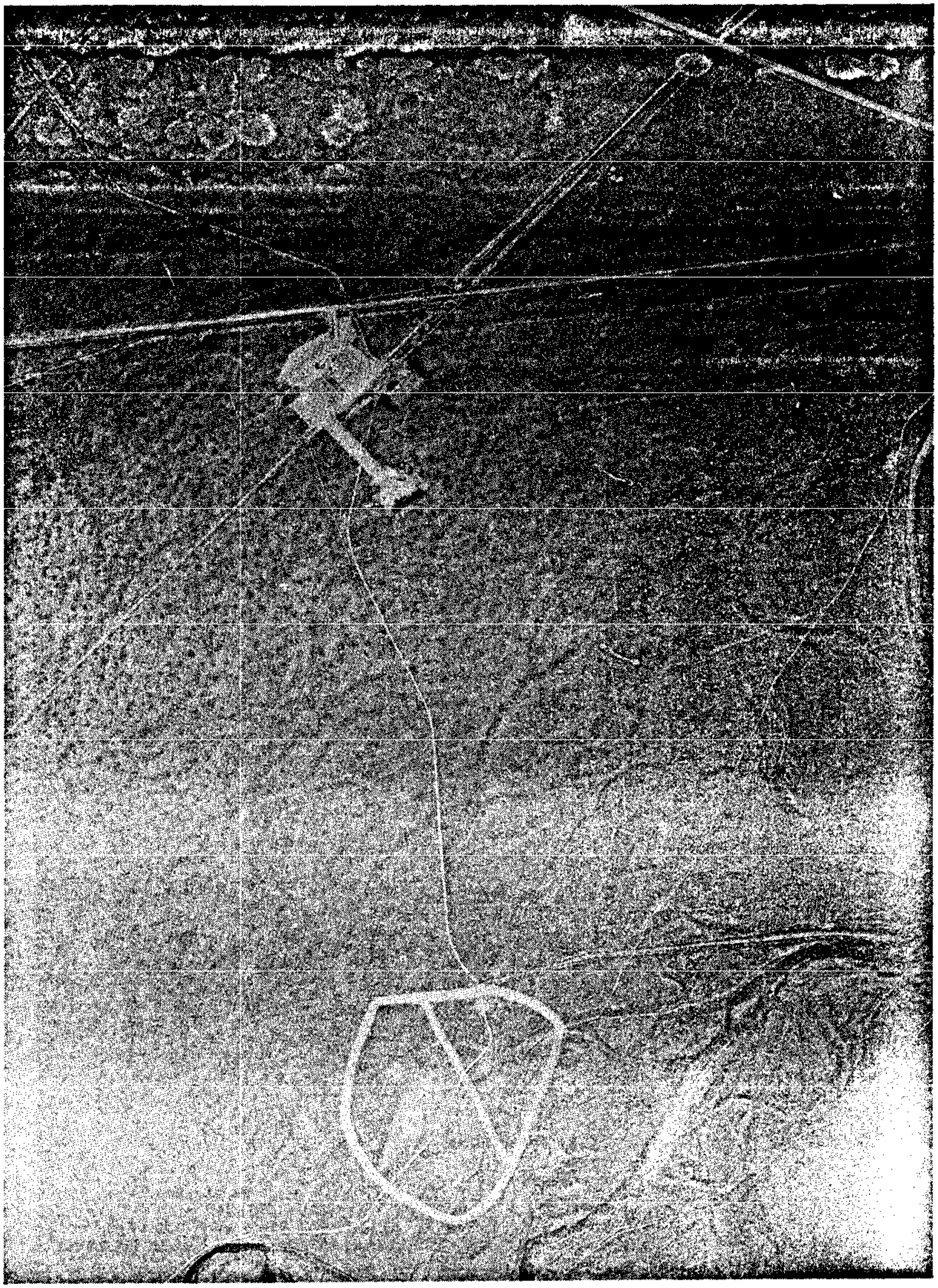

Figure C.11. Naval Ordnance Disposal Area.

Figure C.12. Explosives storage bunkers north of ICPP.

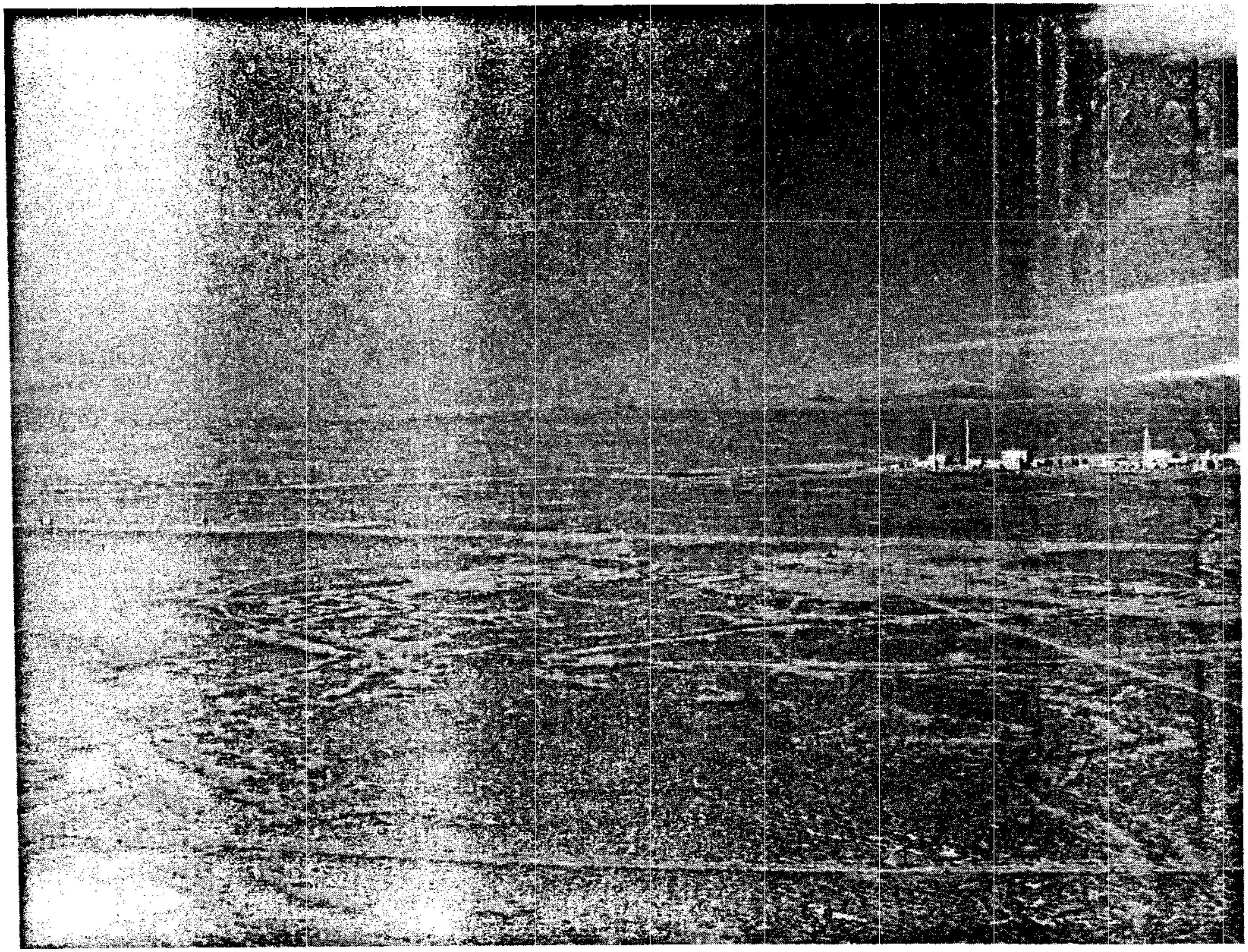

Figure C.13. National Oceanic and Atmospheric Administration grid.

Figure C.14. Aerial bombing range (ANL-W).

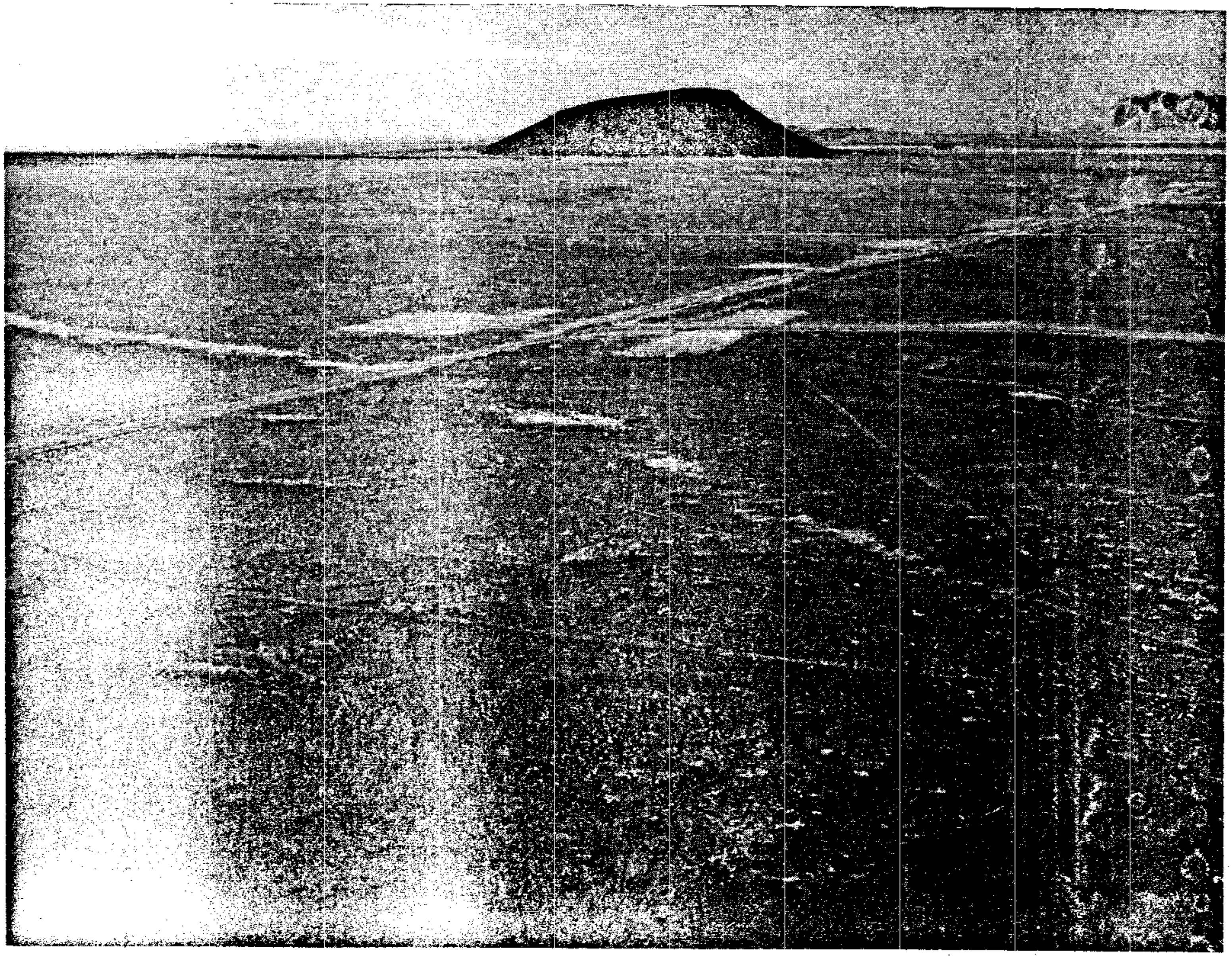

Figure C.15. Aerial bombing range (ANL-W).

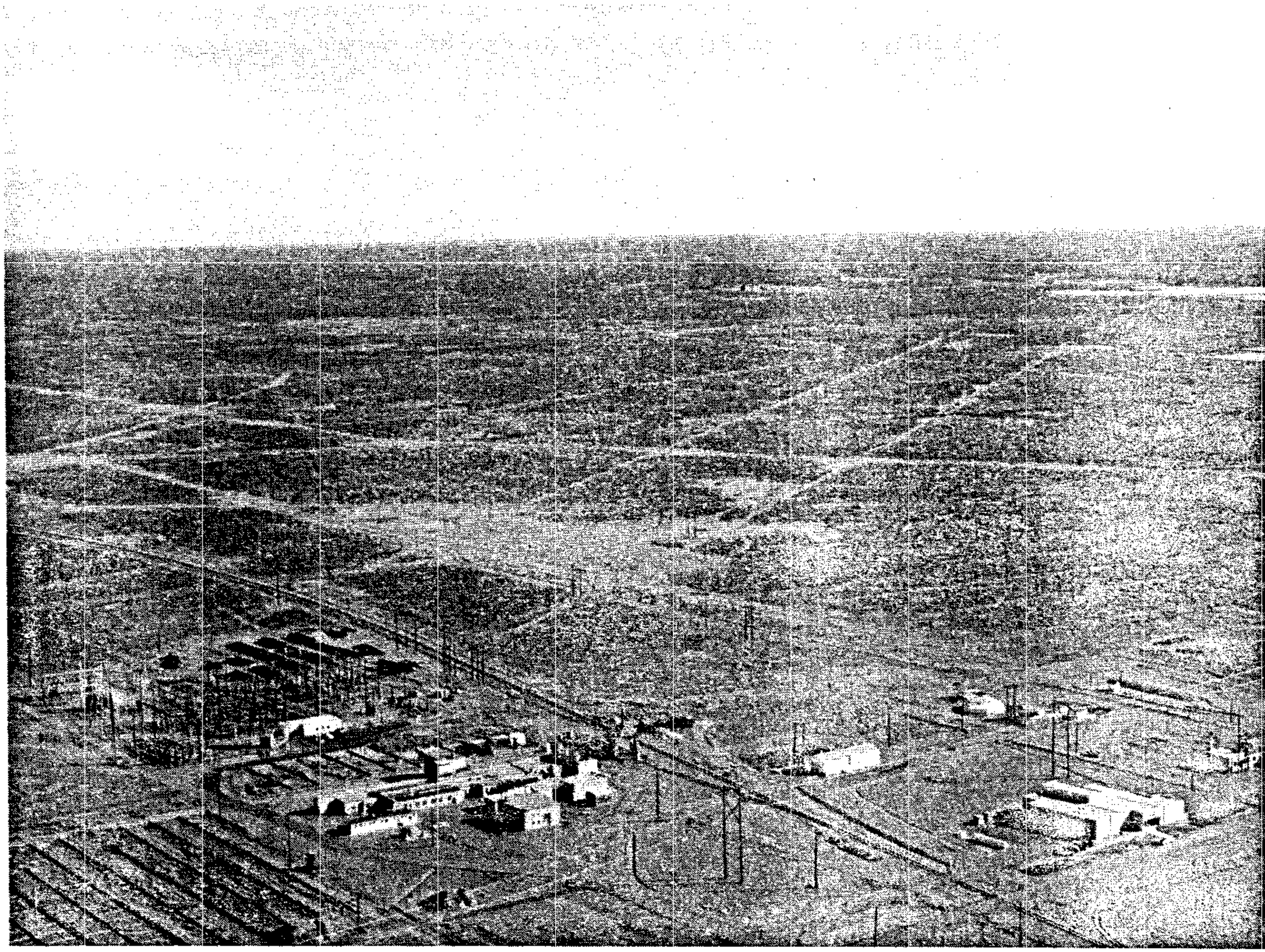

Figure C.16. CF 633 area and downrange zones.

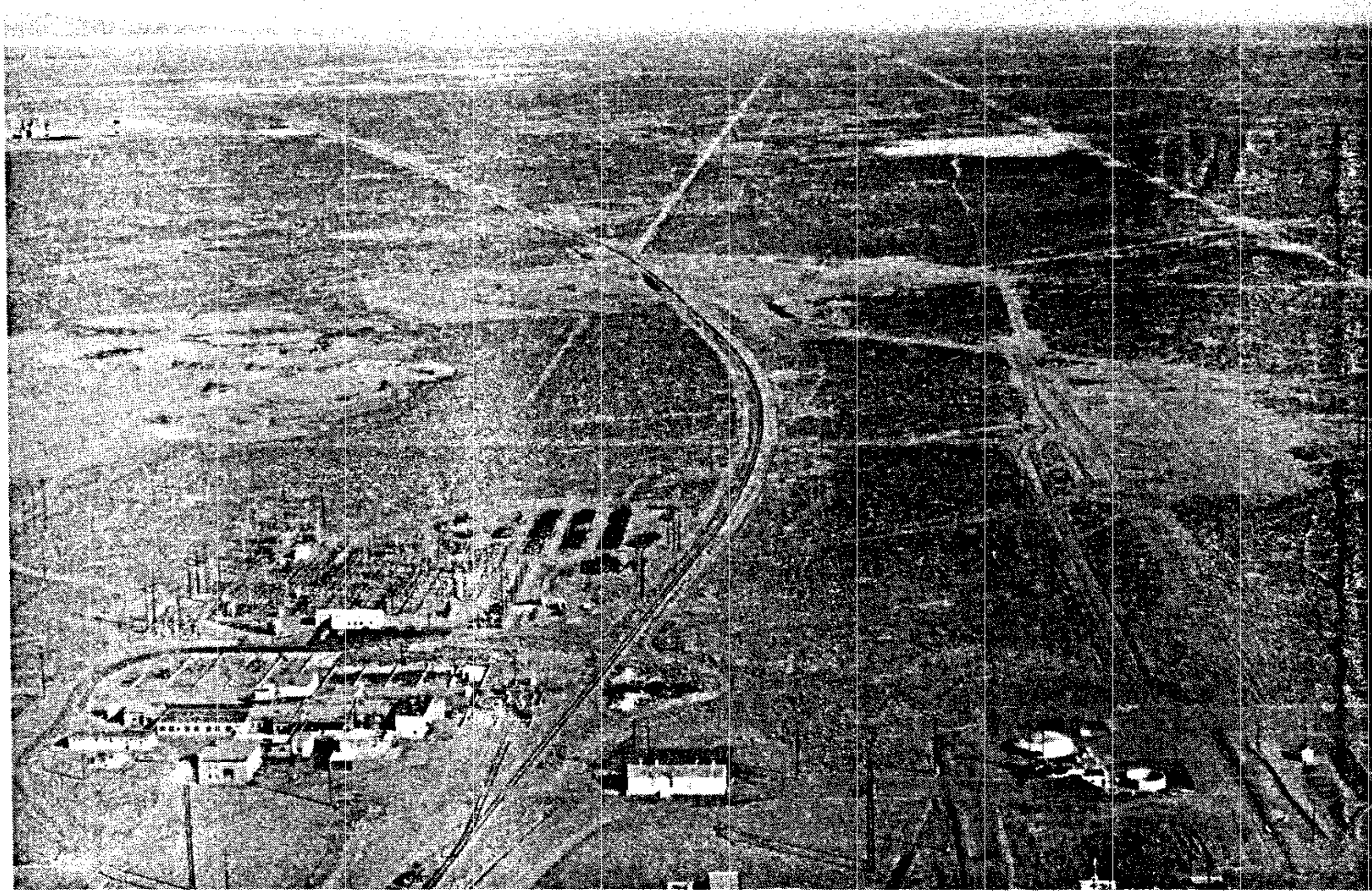

Figure C.17. CF 633 area and downrange zones.

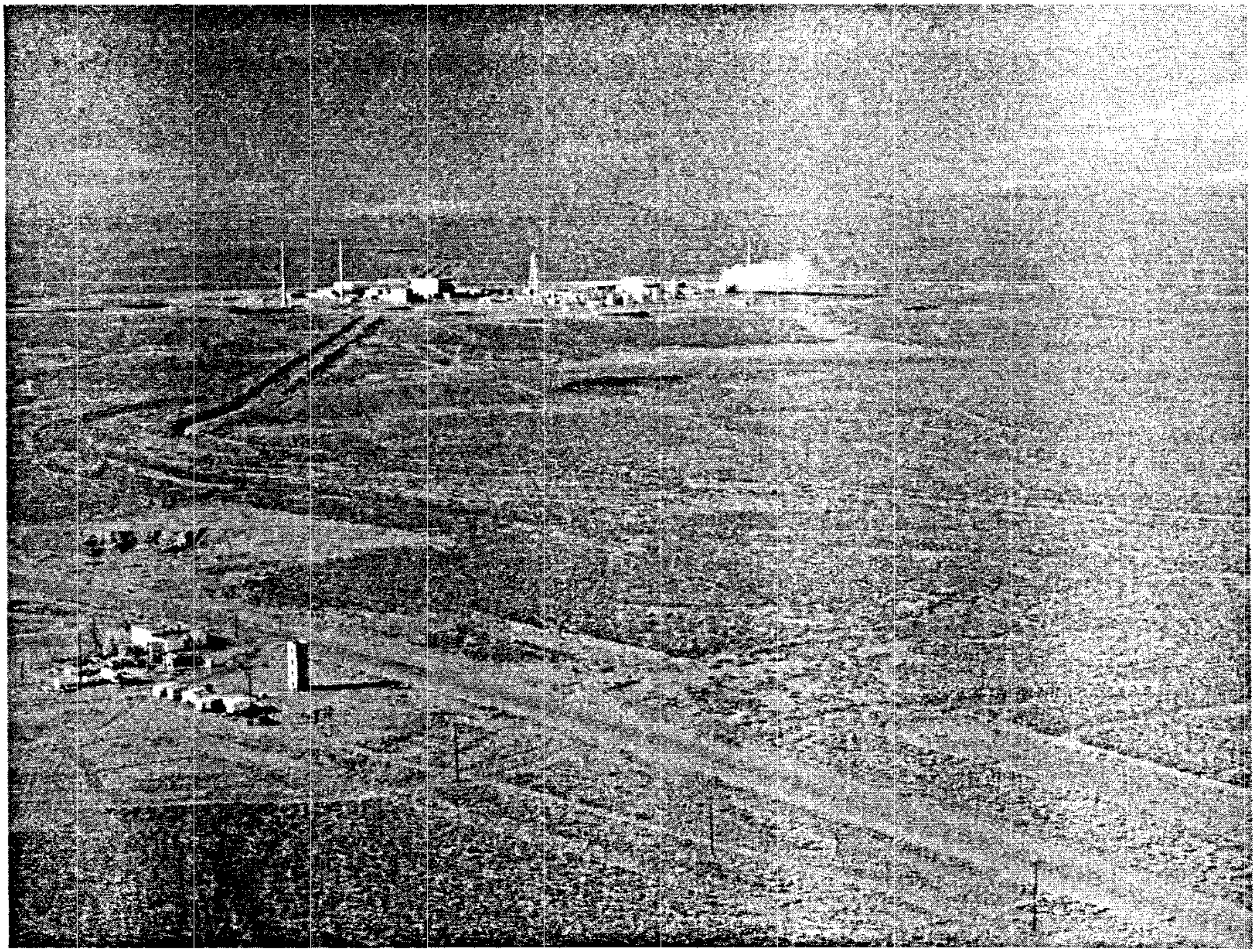

Figure C.18. Fire Station II zone--west of Lincoln Boulevard.

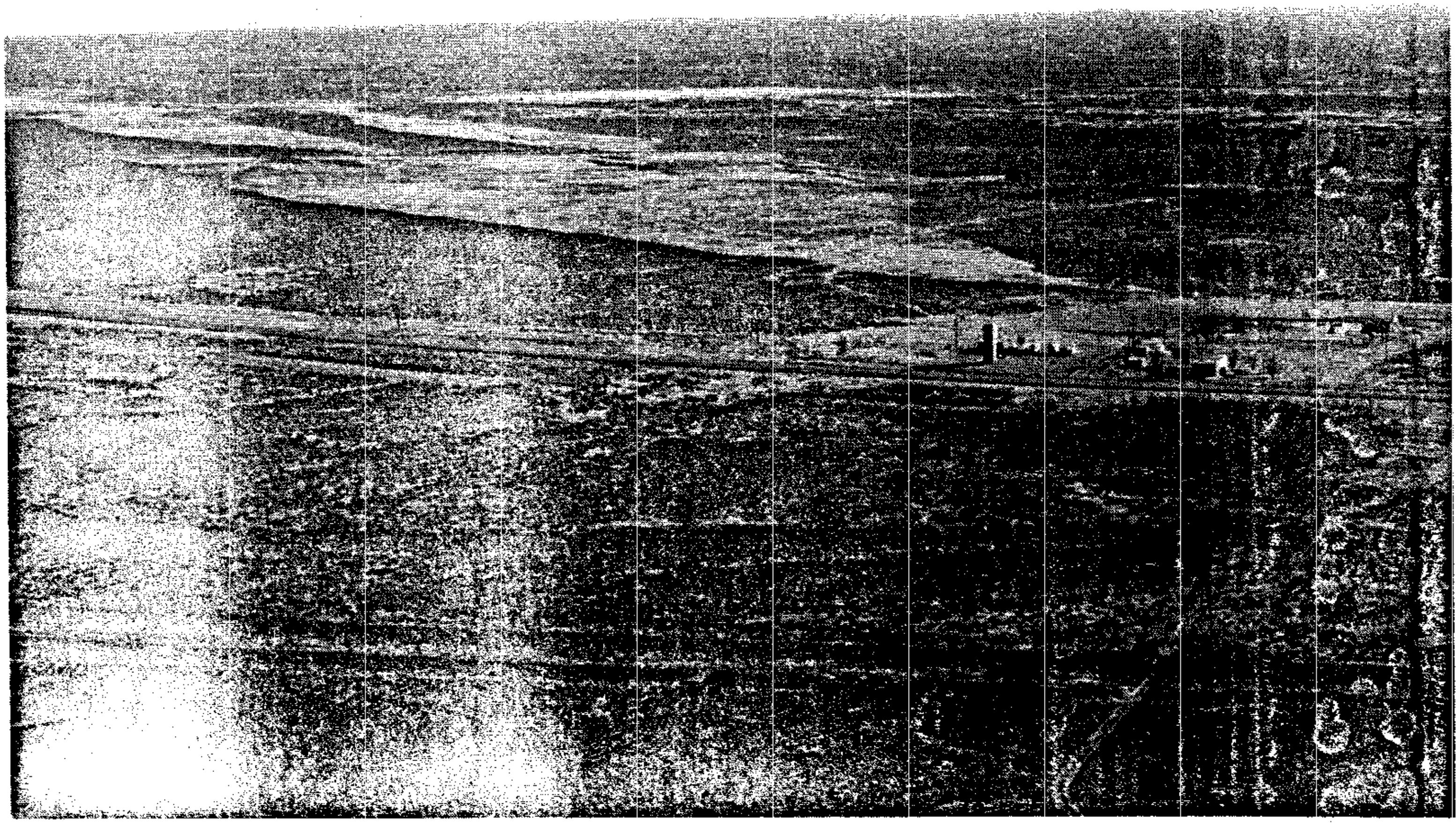

Figure C.19. Range-fire burn area (east/northeast of Fire Station II.

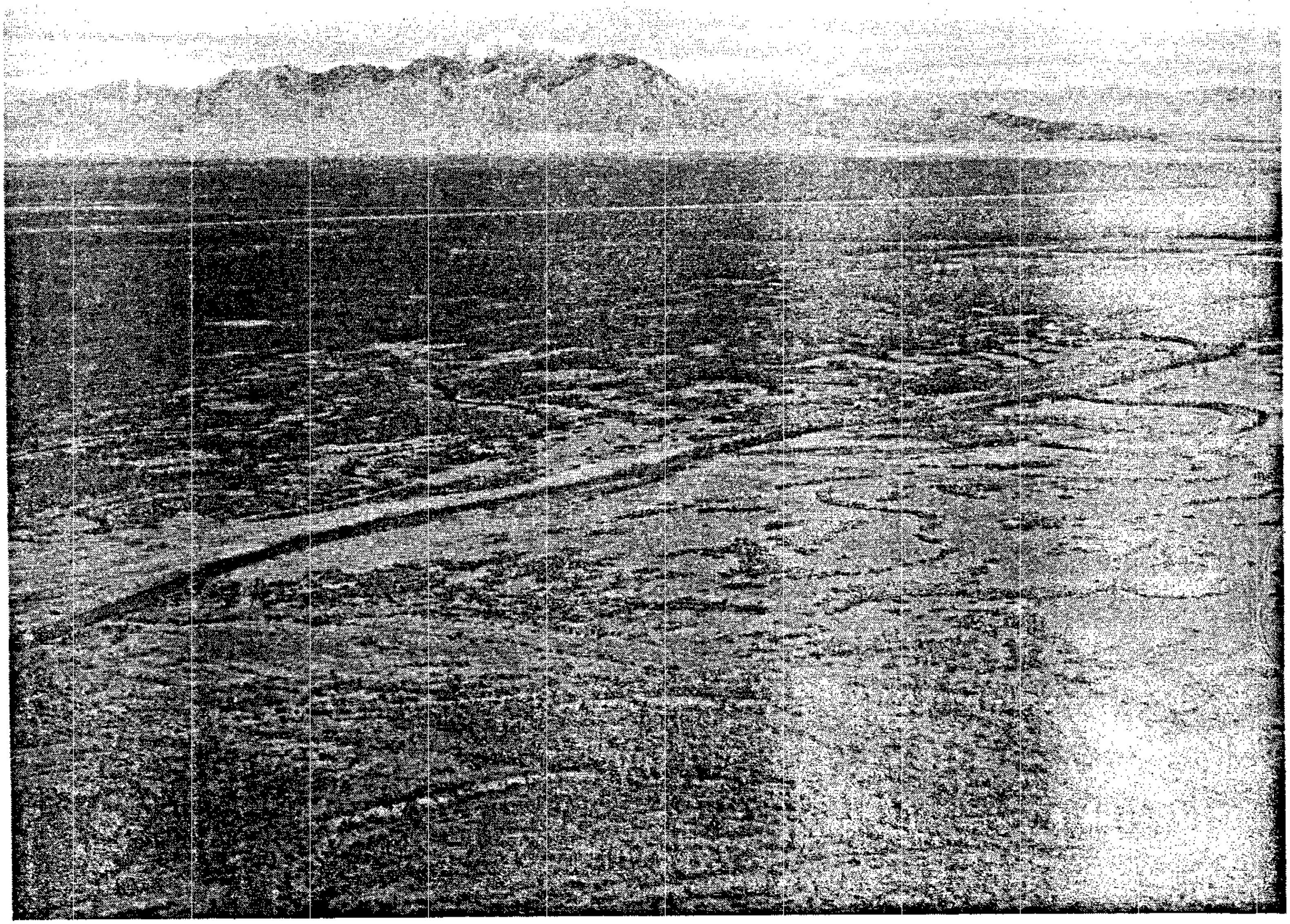

Figure C.20. Zone east of Big Lost River.

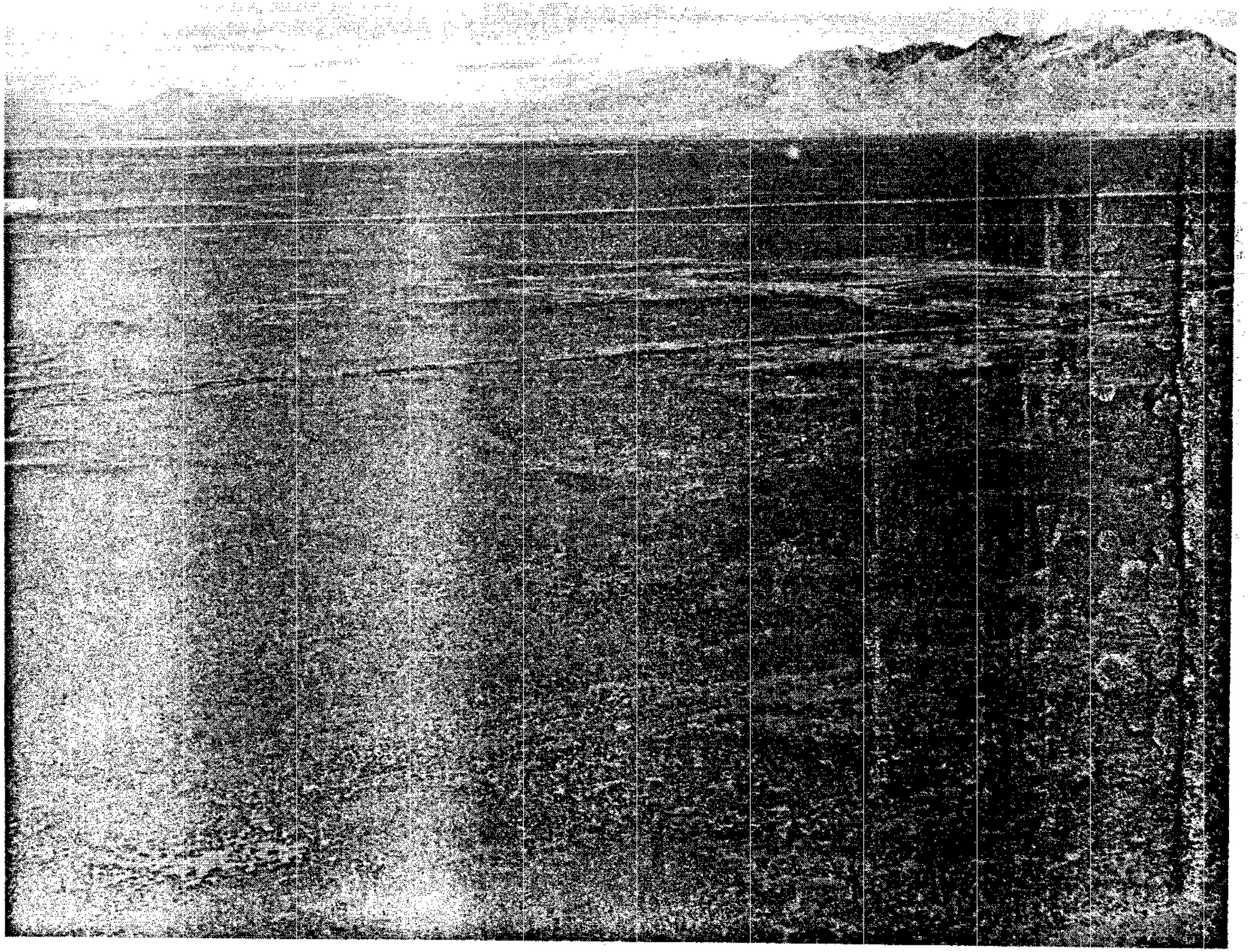

Figure C.21. Zone east of Big Lost River.

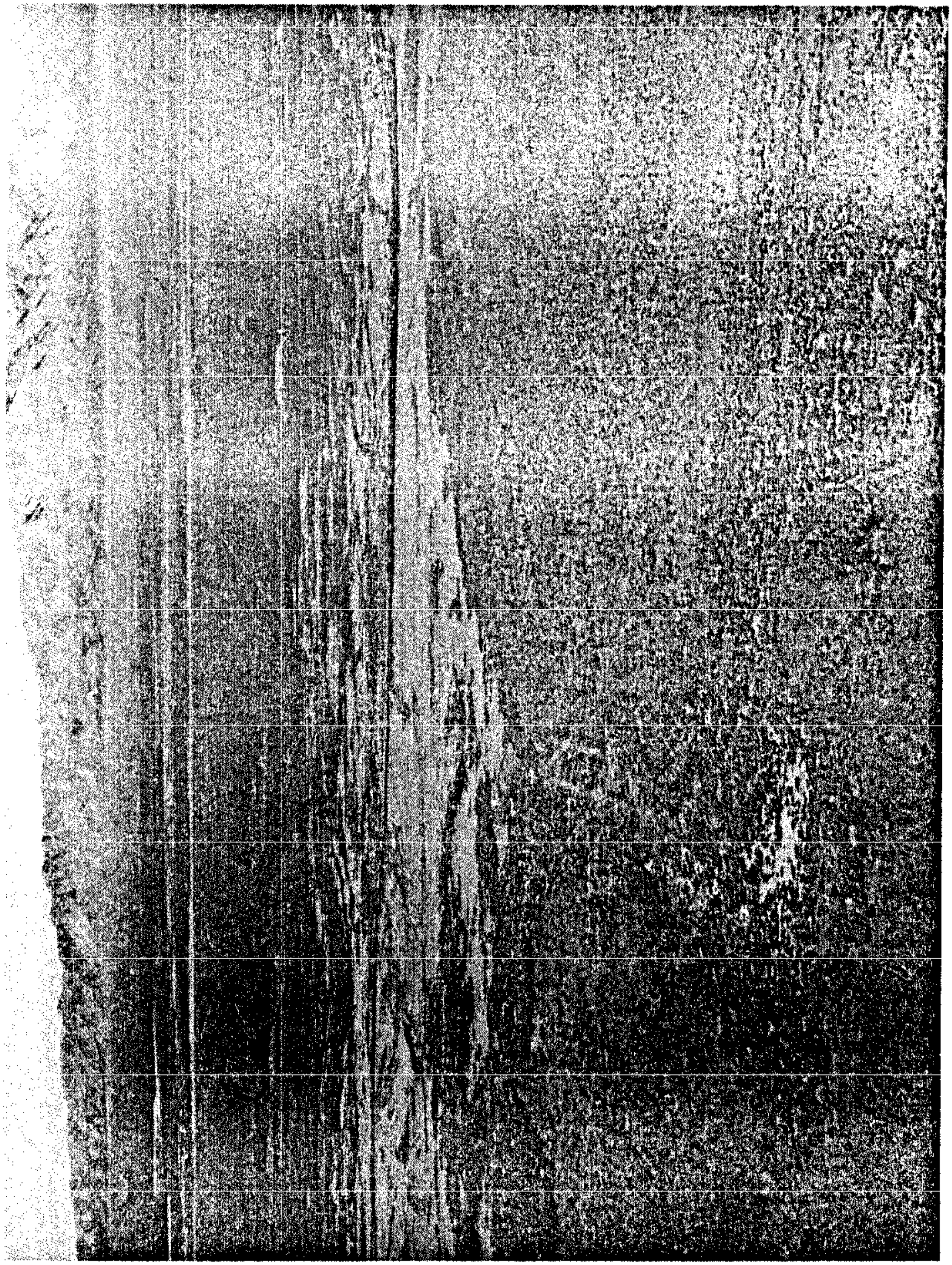

Figure C.22. Zone east of Big Lost River.

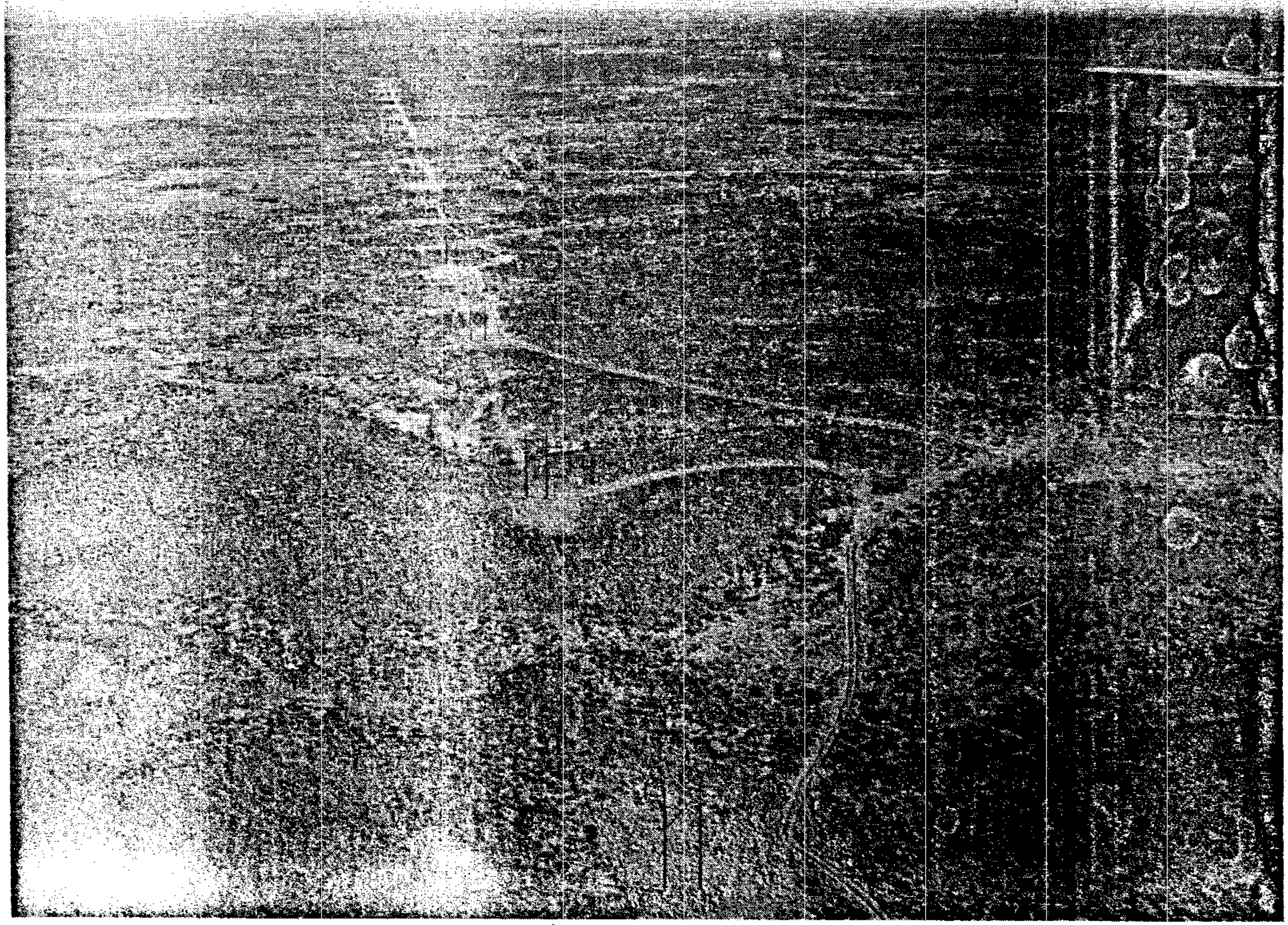

Figure C.23. Anaconda power line.

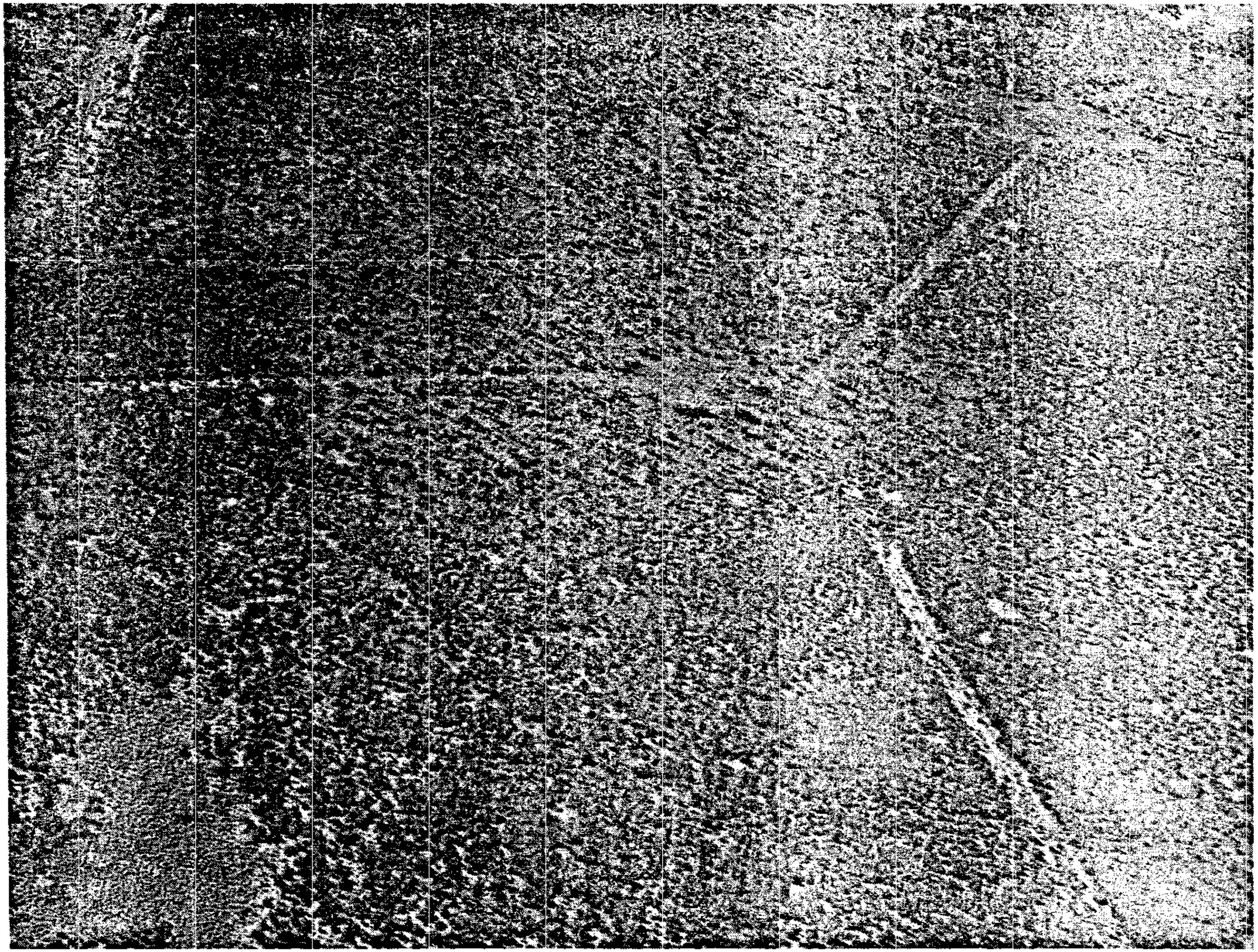

Figure C.24. Old military structures or remnants.

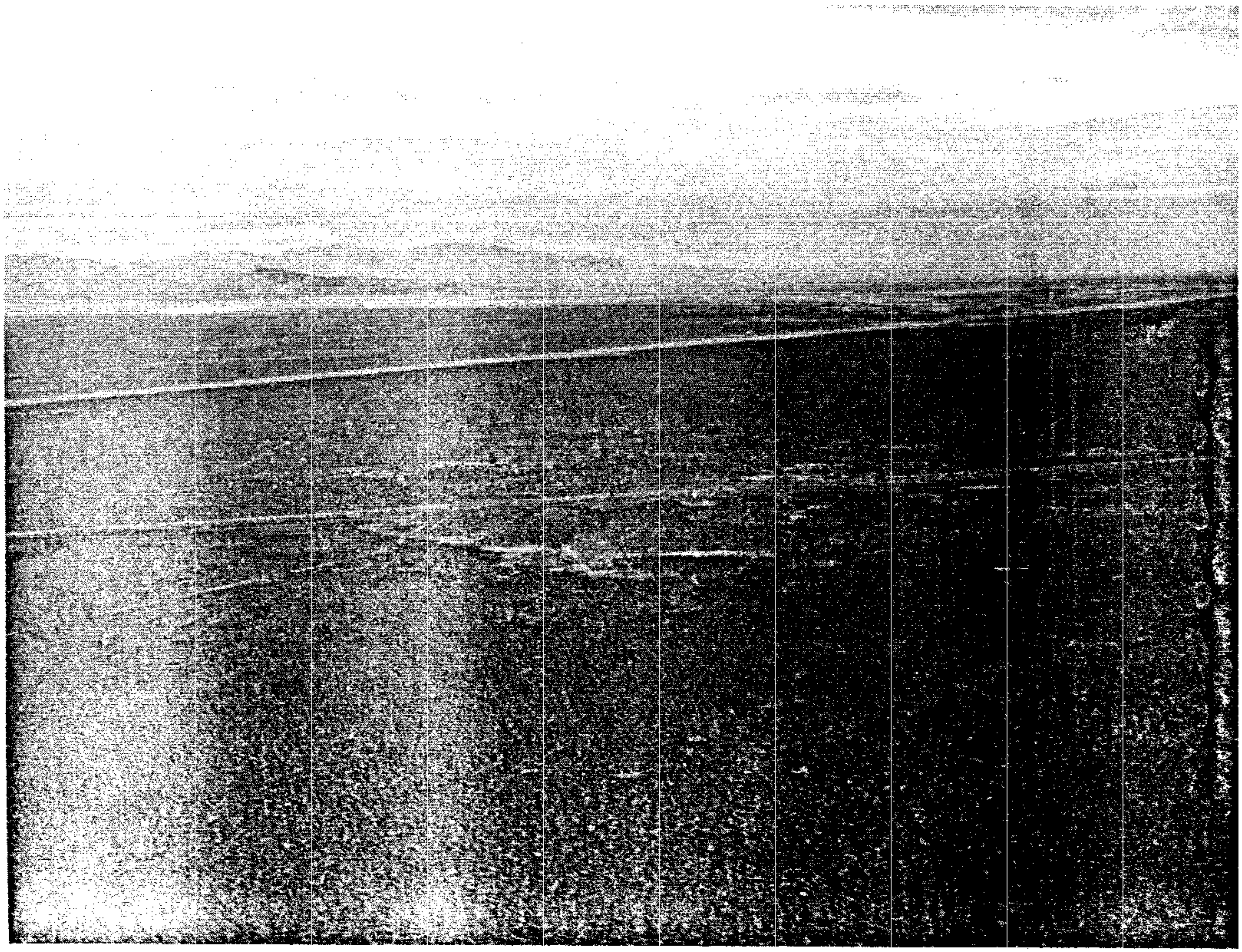

Figure C.25. Old military structures or remnants.

Figure C.26. Large-scale naval magazine test area.

Figure C.27. Large-scale naval magazine test area.

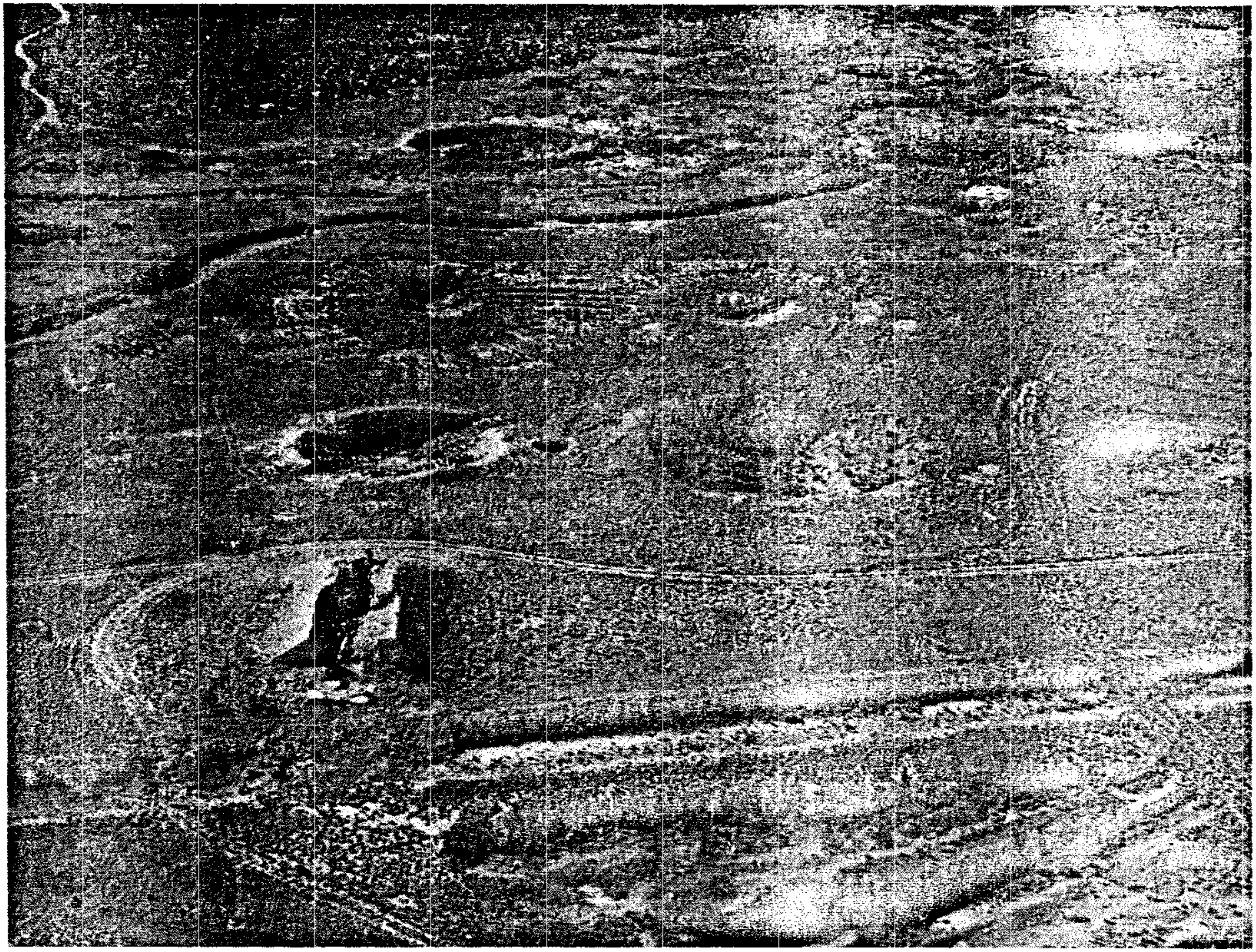

Figure C.28. Large-scale naval magazine test area.

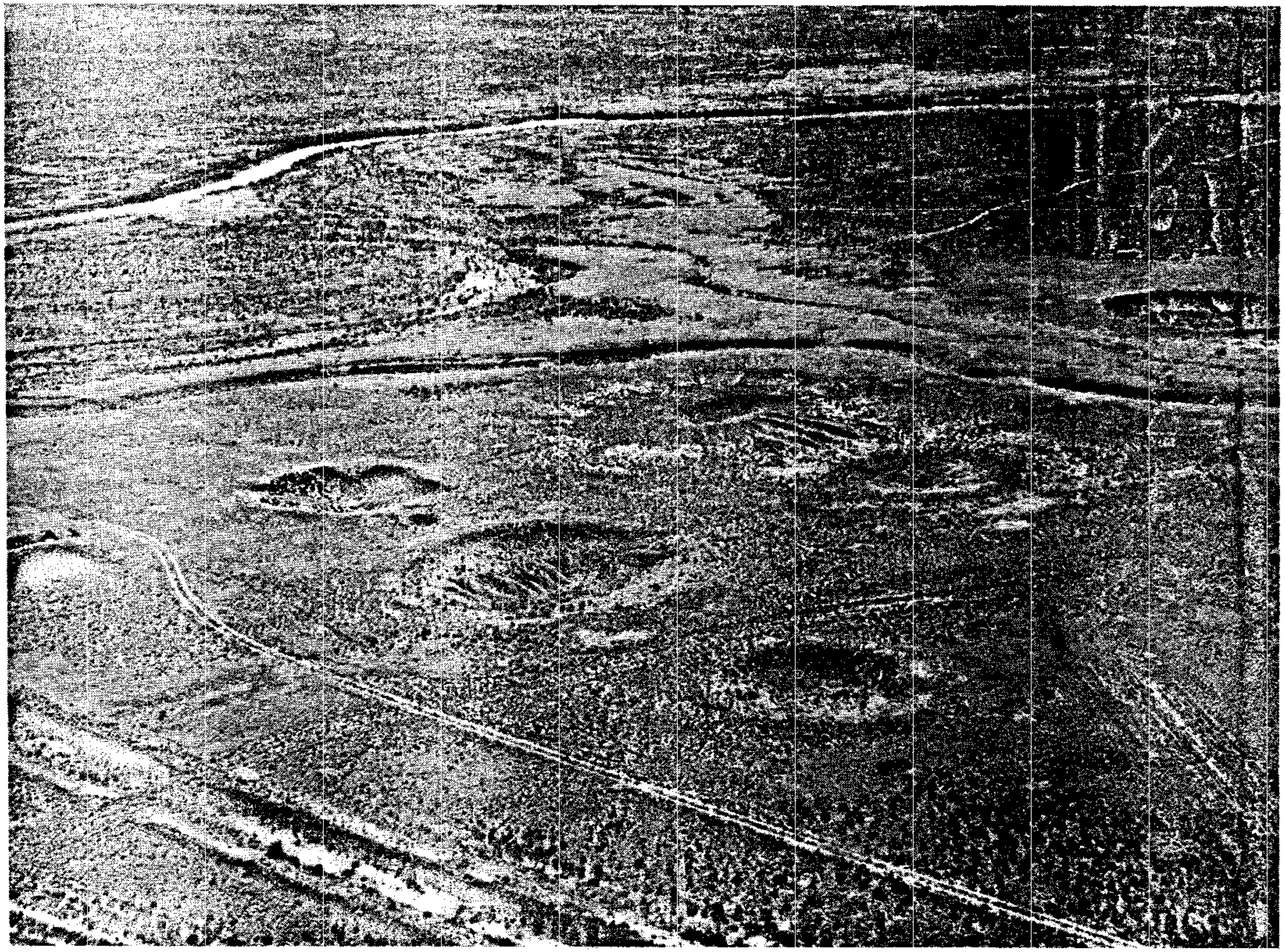

Figure C.29. Large-scale naval magazine test area.

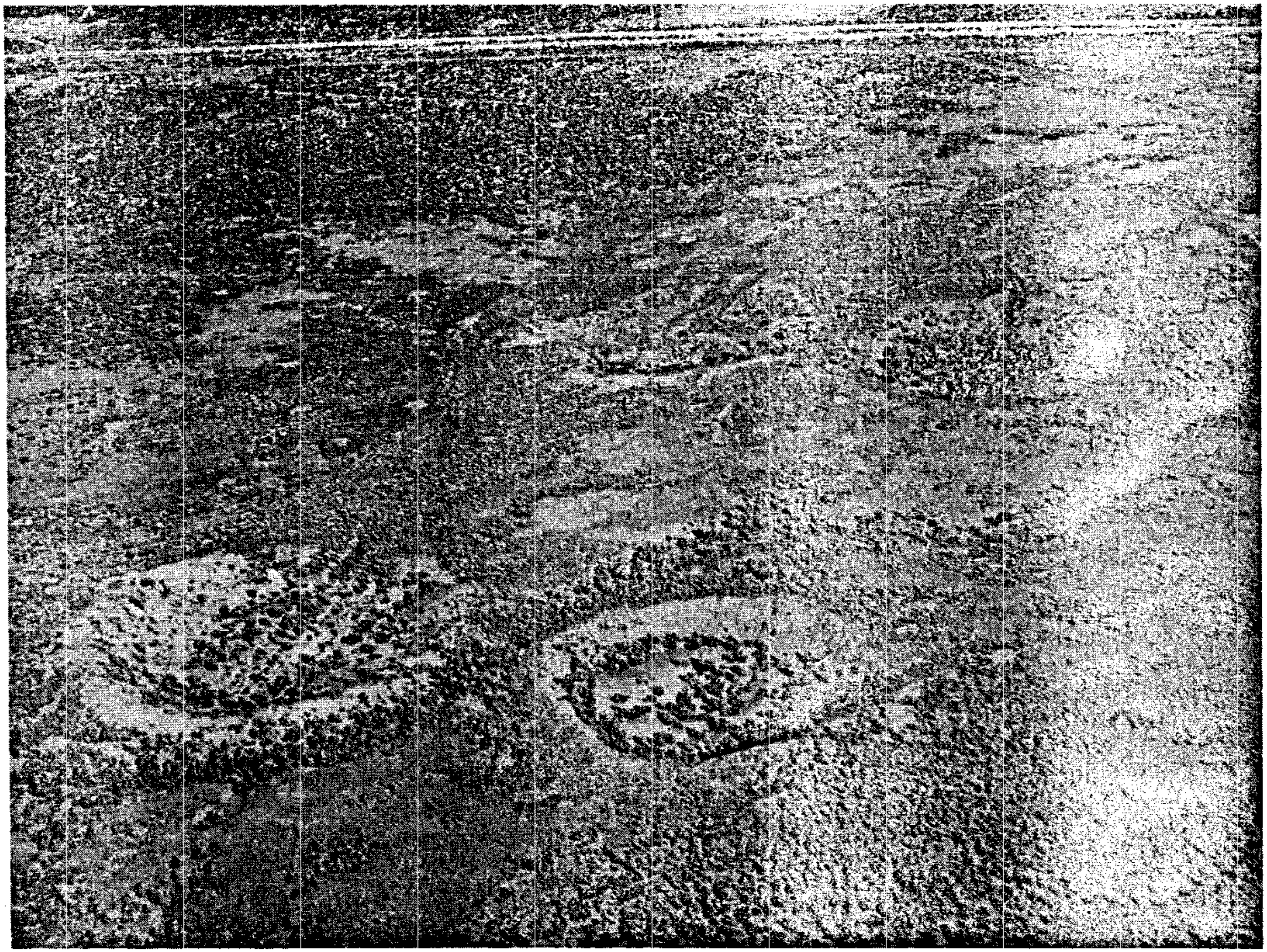

Figure C.30. Large-scale naval magazine test area.

Figure C.31. Large-scale naval magazine test area.

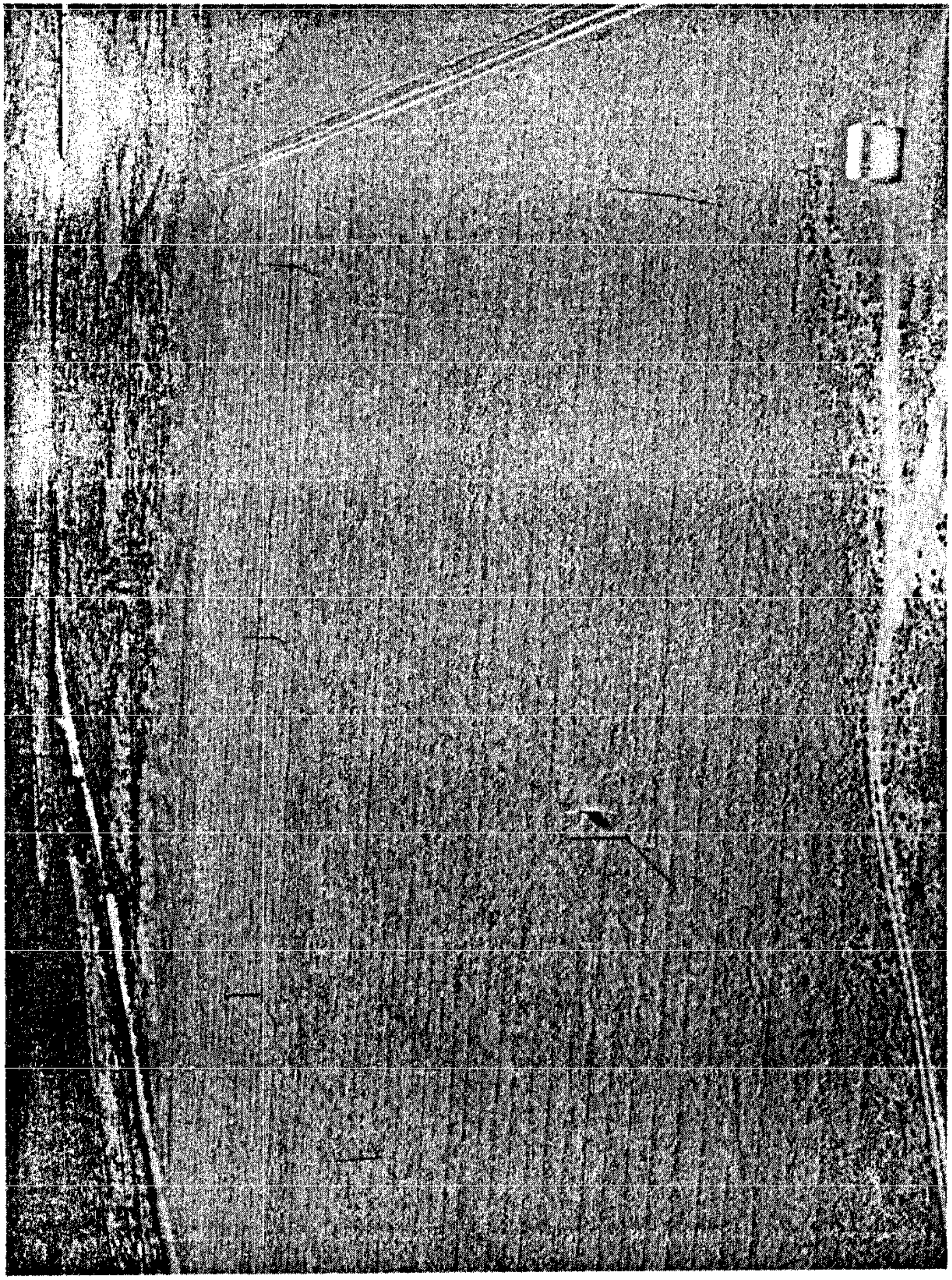

Figure C.32. Dairy Farm revetments.

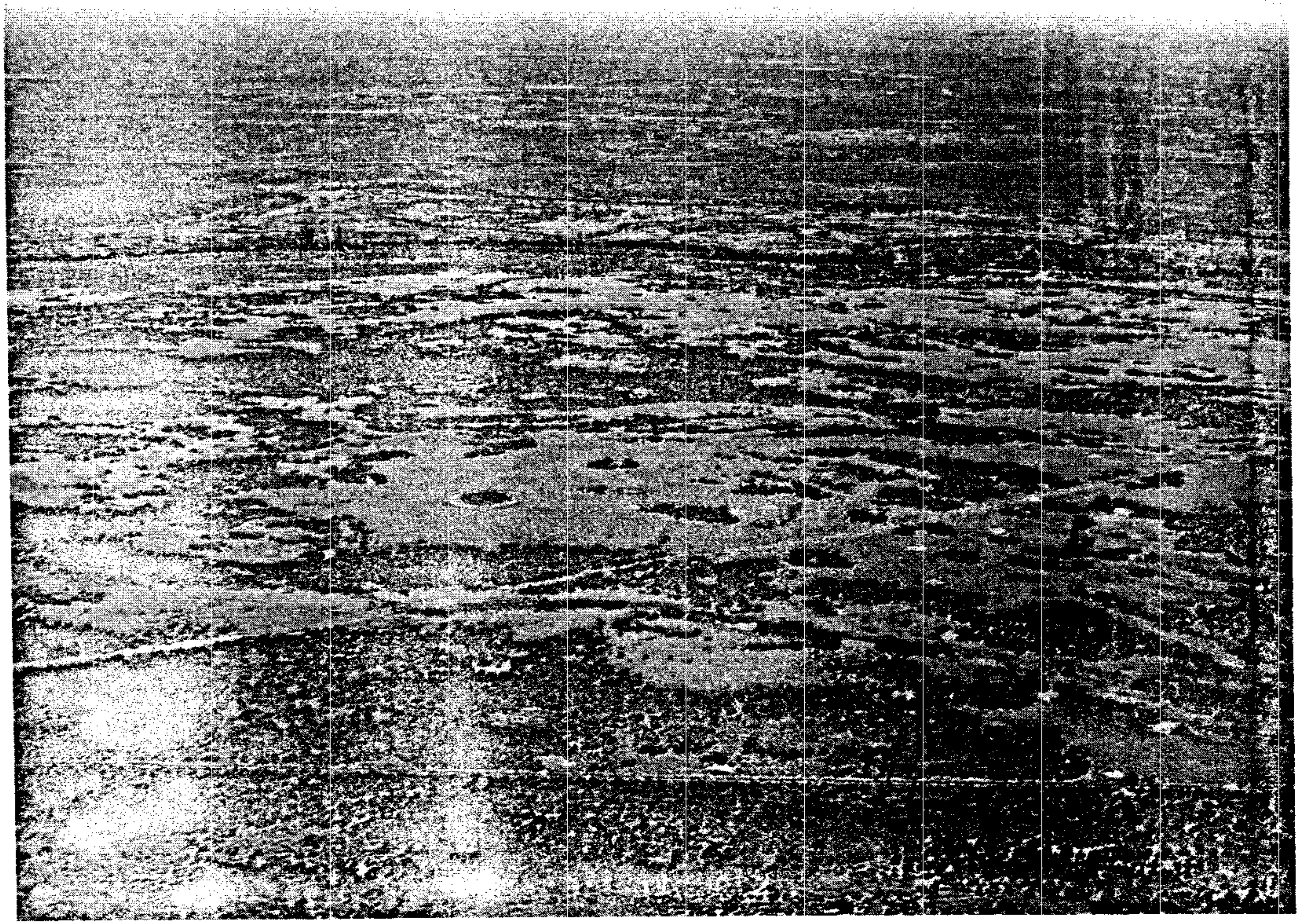

Figure C.33. Dairy Farm revetments.

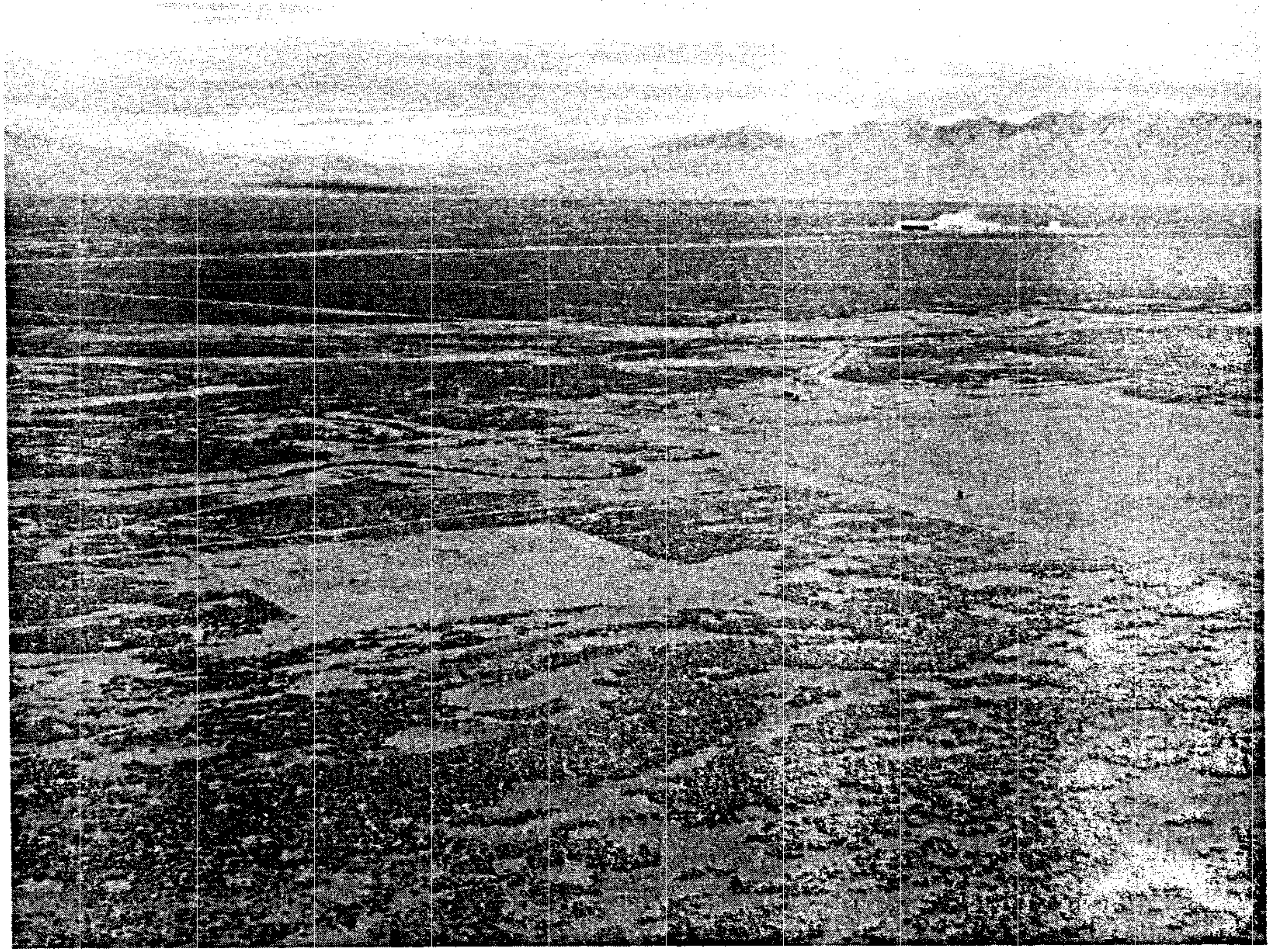

Figure C.34. Dairy Farm revetments.

Figure C.35. Dairy Farm revetments.

APPENDIX D

BIBLIOGRAPHY

APPENDIX D

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Markham, O. D., and D. K. Halford, "Radionuclides in Mourning Doves Near a Nuclear Facility Complex in Southeastern Idaho," The Wilson Bulletin, 94, No. 2, June 1982, pp. 185-197.

Reyes, B. D., M. J. Case, and T. P. Zahn, Environmental Surveillance for the INEL Radioactive Waste Management Complex and Other Areas - Annual Report 1984, EGG-2386, August 1985.

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*. Several EG&G internal technical reports were sources of general information. These documents are not included in this Bibliography.

Robertson, J. B., Robert Schoen, and J. T. Barraclough, The Influence of Liquid Waste Disposal on the Geochemistry of Water at the National Reactor Testing Station, Idaho: 1952-70, IDO-22053, U.S. Geological Survey, February 1972.

U.S. Geological Survey, Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho: 1979-1981 Update, IDO-22066, Open File Report 84-230, June 1984.

Facility name: LOFT Disposal Pond (TAN-750)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

The LOFT Disposal Pond is used for the disposition of lightly radioactive wastewater and industrial wastewater. Contamination route of major concern is groundwater.

Chemical Score: $S_M = 6.3$ ($S_{gw} = 10.9$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: $S_M = 5.8$ ($S_{gw} = 10.0$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4] If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity ≈ 109 tons	0 1 2 3 4 5 6 7 8	1	3	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	11	26	
See attachment for radioactive score	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	12 11	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
Well within 2,000' Population < 1,000	Total Targets Score		29	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5] If Line [1] is 0, Multiply [2] x [3] x [4] x [5]		Chemical Radioactive	6264 5742	57,330	
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 10.9 Radioactive S_{gw} = 10.0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	10.9	118.81	10.0	100
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		118.81		100
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		10.9		10
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		6.3		5.8

WORKSHEET FOR COMPUTING S_M

Scoring for Radioactive Waste Characteristics

TAN/LOFT Disposal Pond (TAN-750)

Radioactive Maximum Potential

Group	Nuclide	Total	Conc. Coef.	Conc.(pCi/L)	Score
A	Unid Alpha	8.5×10^{-3}	20	1.7×10^{-1}	3
B	Sr-90+D	4.2×10^{-2}	10	4.2×10^{-1}	
	Unid β & γ	7.8×10^{-2}	100	7.8×10^{0}	
				8.2×10^{0}	11
C	NONE				
D	Co-60	1.2×10^{-1}	10	1.2×10^{0}	
	Cs-137	1.3×10^{-1}	20	2.6×10^{0}	
	Eu-152	2.8×10^{-5}	1	2.8×10^{-5}	
	Tc-99	3.5×10^{-3}	100	3.5×10^{-1}	
				4.2×10^{0}	3
E	NONE				
F	NONE				

Facility name: TAN/IET Injection Well (TAN-332)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis   Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

The TAN/IET Injection Well received ion exchange column regenerants. The well injected wastewater directly to the aquifer. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 9.5 (S_{gw} = 16.5 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	45	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
3 Containment	0 1 2 3	1		3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity ≈ 2 Ton	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	10 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 1 to 2 mi Population < 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	12	40	
	Total Targets Score		21	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		9,450	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 16.5 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	16.5	272	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		272		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		16.5		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		9.5		0

WORKSHEET FOR COMPUTING S_M

Facility name: TAN/IET Hot Waste Tank (TAN-319)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis　　Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

The IET Hot Waste Tank was part of the IET radioactive wastewater collection system. Once in the tank, water was either pumped to TSF or trucked to ICPP. The underground tank now contains contaminated sludge. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 2.4 (S_{gw} = 4.2 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0.1 (S_{gw} = 0.2 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	1	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Mercury	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity Sludge Vol. ≈ 1600 gal	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	1	26	
See attachment for radioactive scoring	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	19 1	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 1 to 2 mi. Population < 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	12	40	
	Total Targets Score		21	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5		Chemical	2,394	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5		Radioactive	126		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 4.2 Radioactive S_{gw} = 0.2				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	4.2	18	0.2	0.04
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		18		0.04
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		4.2		0.2
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		2.4		0.1

WORKSHEET FOR COMPUTING S_M

Scoring for Radioactive Waste Characteristics

TAN/IET Hot Waste Tank (TAN-319)

Radioactive Maximum Potential

Group	Nuclide	Total	Cor. Coef.	Conc.(pCi/L)	Score
A	NONE				
B	Sr 90 + D	9.8×10^{-3}	10	9.8×10^{-2}	1
C	NONE				
D	Co-60	7.7×10^{-5}	10	7.7×10^{-4}	
	Cs-137	8.0×10^{-4}	20	1.6×10^{-2}	
	U-235	7.2×10^{-6}	20	1.4×10^{-4}	
				1.7×10^{-2}	0
E	NONE				
F	NONE				

Facility name: IET Sanitary Sewer System Septic Tank

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

The sludge remaining in the IET septic tank was found to contain measureable concentrations of some radionuclei. Groundwater is the major contamination route of concern.

Chemical Score: S_M = 0 (S_{gw} = 0 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4] If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	2	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
See attachment for radioactive scoring	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	0 0	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	12	40	
Well within 1 to 2 mi. Population < 1,000					
	Total Targets Score		21	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]	Chemical		0	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]	Radioactive		0		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 0	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	0	0	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		0		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		0		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		0		0

WORKSHEET FOR COMPUTING S_M

TAN/IET Sanitary Sewer System Septic Tank

Radioactive Maximum Potential

Group	Nuclide	Total	Cor. Coef.	Conc.(pCi/L)	Score
A	NONE				
B	Sr-90	1.8×10^{-4}	10	1.8×10^{-3}	0
C	Cs-137	2.9×10^{-5}	20	5.8×10^{-4}	0
D	NONE				
E	NONE				
F	NONE				

Facility name: TAN/WRRTF Injection Well (TAN-331)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This injection well received industrial wastewater and treated sanitary sewage. Discharges included ion exchange column regenerant and one instance of a small amount of radioactive contamination. The well injected directly to the aquifer. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 14.5 (S_{gw} = 25.0 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 1.3 (S_{gw} = 2.3 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	45	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
3 Containment	0 1 2 3	1		3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity ≈ 112 drums	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential 5×10^{-2} Ci of Co-60 $\times 10 = 5\times10^{-1}$ of Group D	0 1 3 7 11 15 21 26	1	1	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	11 1	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population < 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		14,355	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		1,305		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 25.0 Radioactive S_{gw} = 2.3				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	25.0	625	2.3	5.3
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		625		5.3
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		25.0		2.3
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		14.5		1.3

WORKSHEET FOR COMPUTING S_M

Facility name: TAN/WRRTF Burn Pit

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This landfill operation was used for the disposition of garbage and burnable debris generated at TAN. Included was petroleum products. Materials deposited were burned routinely. Groundwater is the primary contamination route of concern.

Chemical Score: S_M = 6.8 (S_{gw} = 11.8 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Stoddard Solvent	0 3 6 9 12 14 18	1	12	18	
Hazardous Waste Quantity At least 45 drums assume 450	0 1 2 3 4 5 6 7 8	1	3	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	15 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,001' to 1 mi. Population < 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	16	40	
	Total Targets Score		25	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		6,750	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 11.8 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	11.8	139	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		139		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		11.8		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		6.8		0

WORKSHEET FOR COMPUTING S_M

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Hydrazine	0 3 6 9 12 14 18	1	12	18	
Hazardous Waste Quantity less than 55 gal	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	12 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
Well within 2,000' Population < 1,000	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5		Chemical	6,264	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5		Radioactive	0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 10.9 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	10.9	118.81	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		118.81		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		10.9		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		6.3		0

WORKSHEET FOR COMPUTING S_M

Facility name: WRRTF Sewage Lagoon/Evaporation Pond (TAN-762)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined surface impoundment has received those wastewaters that use to go to the injection well. Ion exchange column regenerant is the only suspected hazardous material. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 5.3 (S_{gw} = 9.1 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity ≈ 40 gal	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
Well within 2,000′ Population < 1,000	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	10 / 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5		Chemical	5220	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5		Radioactive	0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 9.1	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	9.1	83	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		83		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		9.1		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		5.3		0

WORKSHEET FOR COMPUTING S_M

Facility name: WRRTF Radioactive Liquid Waste Tank (TAN-735)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 12/2/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This 3,000 gallon underground tank was used to collect wastewater suspected of being radioactively contaminated. The water collected has not exceeded release criteria, but the sludge on the tank bottom has not been tested and probably contains some activity. Groundwater contamination is the route of primary concern.

Chemical Score: S_M = 0 (S_{gw} = 0 S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 4.6 (S_{gw} = 7.9 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4] If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	1	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential Unknown - maximum assumed	0 1 3 7 11 15 21 26	1	26	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	0 26	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population < 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]		Chemical	0	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]		Radioactive	4,524		
[7] Divide Line [6] by 57,330 and Multiply by 100		Chemical S_{gw} = 0	Radioactive S_{gw} = 7.9		

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	0	0	7.9	62.4
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		0		62.4
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		0		7.9
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		0		4.6

WORKSHEET FOR COMPUTING S_M

Facility name: ARA-II, SL-1 Burial Ground

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. M. LaRue   Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

After the nuclear excursion and explosion of the SL-1 reactor at ARA-II (1961), a burial ground was established northeast of the site. Highly contaminated (radioactive) materials, including the reactor vessel were buried here.

Chemical Score: S_M = 0 (S_{gw} = S_{sw} = S_a =   )

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 13.7 (S_{gw} = 23.7 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Facility name: WRRTF Two-Phase Pond (TAN-763)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined surface impoundment receives only wastes from the Two-Phase Loop experiments. Hydrazine is the only contaminant of concern and it is small quantities. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 6.3 (S_{gw} = 10.9 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	26	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1		26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	0 26	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
Well within 2,000' Population 101 to 1,000					
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5 If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Chemical Radioactive		0 13,572	57,330	
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 0		Radioactive S_{gw} = 23.7		

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})			23.7	561.69
Surface Water Route Score (S_{sw})			0	0
Air Route Score (S_a)			0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$				561.69
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$				23.7
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$				13.7

WORKSHEET FOR COMPUTING S_M

Facility name: ARA-III, Radioactive Waste Leach Field

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. M. LaRue   Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined, earthen bottomed leach field was build to receive low-level radioactively contaminated wastewater. In addition to the small quantities of radionuclides, chromium and sliver, also in very small concentrations, have reached the pond by way of the cooling water. Groundwater contamination is the route of primary concern.

Chemical Score: S_M = 10.5 (S_{gw} = 18.2 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 5.8 (S_{gw} = 10.0 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence ~~Chrome~~	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	11	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	20 11	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
Well within 2,000' Population 101 to 1,000	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		10,440	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		5,742		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 18.2 Radioactive S_{gw} = 10.0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	18.2	331.24	10.0	100.0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		331.24		100.0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		18.2		10.0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$ / 1.73 = S_M =		10.5		5.8

WORKSHEET FOR COMPUTING S_M

Facility name: ARA-740, Sanitary Sewer Leach Field

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. M. LaRue Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

The sanitary sewer leach field at ARA-III received very small quantities of various chemicals as a result of chemical research conducted at ARA-621. Groundwater contamination is the route of primary concern.

Chemical Score: S_M = 10.0 (S_{gw} = 17.3 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4]					
If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	19 0	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population 101 to 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]	Chemical		9,918	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]	Radioactive		0		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 17.3	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	17.3	299.29	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S^2_{gw} + S^2_{sw} + S^2_a$		299.29		0
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a}$		17.3		0
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a} / 1.73 = S_M =$		10.0		0

WORKSHEET FOR COMPUTING S_M

Facility name: ARA- 627 Chemical Leach Field

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. M. LaRue Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined, earthen bottomed leach pond is located south of ARA-627. It received wastewater from ARA-I operations which included small quantities of acids, bases, and solvents such as xylene, heptane, and methanol. It also received very small quantities of radioactivity; quantities considered too small for ranking. Groundwater is the contamination route of primary concern.

Chemical Score: $S_M = 5.3$ ($S_{gw} = 9.1$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: $S_M = 0$ ($S_{gw} =$ $S_{sw} =$ $S_a =$)

$S_{FE} =$

$S_{DC} =$

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence xylene	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a.	10	26	
		4b.	0		
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population 101 to 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5		Chemical	5,220	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5		Radioactive	0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 9.1	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	9.1	82.81		
Surface Water Route Score (S_{sw})	0	0		
Air Route Score (S_a)	0	0		
$S_{gw}^2 + S_{sw}^2 + S_a^2$		82.81		
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		9.1		
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		5.3		

WORKSHEET FOR COMPUTING S_M

Facility name: ARA-627 Sanitary Waste Leach Field

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. M. LaRue Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Minor radioactive contamination is suspected in the sanitary waste leach field at ARA-I. The unlined leach field receives liquid waste and probably became contaminated during SL-1 cleanup operation.

Chemical Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 1.6 (S_{gw} = 2.7 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4]					
If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	3	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	0 / 3	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	20	40	
Well within 2,000'					
Population 101 to 1,000					
	Total Targets Score		29	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]	Chemical		0	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]	Radioactive		1,566		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 0		Radioactive S_{gw} = 2.7		

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})			2.7	7.29
Surface Water Route Score (S_{sw})			0	0
Air Route Score (S_a)			0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$				7.29
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$				2.7
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$				1.6

WORKSHEET FOR COMPUTING S_M

Facility name: ARA-627 Pad adjacent and south of building

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. M. LaRue Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

A source of radiation was found under a trailer pad just south of ARA-627

It is suspected that the source is residue from the SL-1 cleanup operation.

Chemical Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0.3 (S_{gw} = 0.5 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	0	3	
	Total Route Characteristics Score		3	15	
3 Containment	0 1 2 3	1	1	3	3.3
4 Waste Characteristics					3.4
Chemical a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	3	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	0 3	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population 101 to 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		0	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		261		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 0	Radioactive S_{gw} = 0.5			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})			0.5	0.25
Surface Water Route Score (S_{sw})			0	0
Air Route Score (S_a)			0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$				0.25
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$				0.5
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$				0.3

WORKSHEET FOR COMPUTING S_M

APPENDIX E

HAZARD RANKING SYSTEM CALCULATIONS
(Ranking Sheets for Each Facility)

APPENDIX E

HAZARD RANKING SYSTEM CALCULATIONS

This appendix provides copies of the standardized worksheets used to calculate the HRS and MHRS scores for each site. The Migration Score (Sm) discussed in Section 5.0 is actually a composite of three separate route scores: Ground Water Route Score (Sgw), Surface Water Route Score (Ssw), and Air Route Score (Sa). Worksheets for Ssw and Sa are not included in this appendix because these scores were zero in all cases. The Ssw was zero because surface water entering the INEL does not leave the site and is not used and/or the containment element of the worksheet received a zero. The Sa was always zero because there has been no documented observed air release of a hazardous substance from a disposal site.

There were several instances in which a strict application of the HRS was not used so that the scores would represent a higher, more conservative estimate of the migration potential. The primary examples of these variations are as follows:

- When the quantities of hazardous waste are unknown, the HRS directs that a zero be assigned to this sub-element. In the scoring shown in this appendix, whenever an "educated guess" could be made as to the quantities involved, it was used to assign a non-zero value.

- If they were the only wastes released at the site, even quantities below the applicable Reportable Quantity (per 40 CFR Part 302) were evaluated rather than giving the site a zero.

- The assumption was made that injection wells injecting wastes directly into the aquifer represented an "Observed Release" for scoring purposes. The HRS indicates that the "Observed Release", which leads to a higher score, is to be positive only when there is analytical evidence (samples) of the release.

The worksheets are grouped in the general facility areas as presented in Sections 4.0 and 5.0. Within the facility areas, the sites are prioritized by highest score. The sites and their locations in this appendix are provided below:

Facility name: TRA Warm Waste Leach Pond (TRA-758)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis　　Date: 10/31/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This pond is an unlined surface impoundment designed to receive radioactivity contaminated wastewater from the Test Reactor Area (TRA).

Contamination route of major concern is groundwater

Chemical Score: $S_M = 51.9$ ($S_{gw} = 89.8$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: S_M 51.9 (S_{gw} 89.8 $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	45	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
3 Containment	0 1 2 3	1		3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity 4,400 Tons	0 1 2 3 4 5 ~~6~~ 7 8	1	8	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 ~~26~~	1	7	26	
b.2 Maximum Potential	0 1 3 ~~7~~ 11 15 21 26	1	26	26	
See radioactive scoring attached	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	26 26	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 ~~8~~ 10 12 16 18 ~~20~~ 24 30 32 35 40	1	35	40	
Well within 2,000' Population within 3mi. of site and plume is 3,000 to 10,000	Total Targets Score		44	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		51,480	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		51,480		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 89.8		Radioactive S_{gw} = 89.8		

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	89.8	8064.0	89.8	8064.0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$				8064.0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$				89.8
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$				51.9

WORKSHEET FOR COMPUTING S_M

Scoring for Radioactive Waste Characteristics

TRA Warm Waste Leach Pond

4.b Max. Observed

Group	Nuclide	Concentration	Score
D	Co^{60}	21.9 pci/L	3
F	H^3	1×10^5 pCi/L	7

4.b Max Potential

Group	Nuclide	Total	Cor. Coef.	Con.(pCi/L)	Score
A	Unid Alpha	2.8×10^0	20	56×10^0	15
B	I^{129}	1.4×10^{-7}	100	1.4×10^{-5}	
	Sr^{90}+D	5.1×10^2	10	5.1×10^3	
	Unid β & γ	8.0×10^3	100	8×10^5	
				$\sim 8 \times 10^5$	26

Facility name: TRA Warm Waste Retention Basin (TRA-712)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis   Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Underground retention basin for all wastewater going to the Warm Waste Leach Pond. This concrete basin was found to be leaking in the early 1970s. Contamination route of major concern is groundwater.

Chemical Score: $S_M = 22.0$ ($S_{gw} = 38$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: $S_M = 41.9$ ($S_{gw} = 72.5$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	45	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4] If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
[3] Containment	0 1 2 3	1		3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence NaOH	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 12 Tons	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	7	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	21	26	
See radioactive scoring attached	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	11 21	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	35	40	
	Total Targets Score		44	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5] If Line [1] is 0, Multiply [2] x [3] x [4] x [5]		Chemical Radioactive	21,780 41,580	57,330	
[7] Divide Line [6] by 57,330 and Multiply by 100		Chemical S_{gw} = 38.0	Radioactive S_{gw} = 72.5		

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	38.0	1444	72.5	5256
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		1444		5256
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		38.0		72.5
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		22.0		41.9

WORKSHEET FOR COMPUTING S_M

TRA Warm Waste Retention Basin

4.b Max. Observed

Group	Nuclide	Concentration	Score
D	Co-60	21.9 pCi/L	3
F	H^3	1×10^5 pCi/L	7

4.b Max. Potential

Group	Nuclide	Total	Cor. Coef.	Con.(pCi/L)	Score
A	Unid Alpha	2.27×10^0	20	4.5×10^1	21
B	I-129	7.0×10^{-9}	100	7.0×10^{-6}	
	Sr+90+D	2.5×10^1	10	2.5×10^2	
	Unit β & γ	4.0×10^2	100	4.0×10^4	
				4.0×10^4	21
C	Cs-134	1.1×10^0	20	2.2×10^1	
	Np-237+D	8×10^{-1}	2	1.6×10^0	
				2.3×10^1	7
D	Co-60	1.2×10^1	10	1.2×10^2	
	Cs-137	5.3×10^0	20	1.1×10^2	
	Na-24	1.25×10^2	100	1.25×10^4	11
E	Np-239	8.0×10^{-1}	2	1.6×10^0	
	Sb-125	1.5×10^{-1}	20	3.0×10^0	
				4.6×10^0	1
F	H^3	4.2×10^2	100	4.2×10^4	7

Half of 1962 to 81 total + 1982 to 85 figures all ÷ by 10 (10% leaked)

Facility name: TRA Waste Disposal Well

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Inactive well that was used to inject wastewater directly into the aquifer. Contamination route of major concern is groundwater.

Chemical Score: S_M = 39.9 (S_{gw} = 69.1 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC}

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	45	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
3 Containment	0 1 2 3	1		3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity 15 Ton	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	20 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	35	40	
	Total Targets Score		44	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5		Chemical	39,600	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5		Radioactive	0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 69.1	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	69.1	4775	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		4775		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		69.1		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		39.9		0

WORKSHEET FOR COMPUTING S_M

Facility name: TRA Chemical Waste Pond (TRA-701)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis   Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This is an unlined pond that received regenerant solutions - acids and caustics. Contamination route of major concern is groundwater.

Chemical Score: S_M = 12.0 (S_{gw} = 20.8 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 13,000 Tons	0 1 2 3 4 5 6 7 8	1	8	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	17 / 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	30	40	
Well within 2,000' Population with 1,001 to 3,000					
	Total Targets Score		39	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		11,934	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 20.8	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	20.8	432.64	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		432.64		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		20.8		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		12.0		0

WORKSHEET FOR COMPUTING S_M

Facility name: TRA Open Loading Dock (TRA-722)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis   Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

There has been apparent leakage of materials from drums stored on this old wood loading dock at TRA. During two successive visits, oily appearing liquid was seen accumulated under the dock. Material could contain halogenated solvent - assume 1 to 40 drums have been spilled. Contamination route of primary concern is groundwater.

Chemical Score: S_M 9.2 (S_{gw} 15.9 S_{sw} = 0 S_a = 0)

S_{FE}

S_{DC}

Radioactive Score: S_M 0 (S_{gw} S_{sw} S_a)

S_{FE} =

S_{DC}

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Trichloroethane	0 3 6 9 12 14 18	1	12	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	13 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	30	40	
Well within 2000' Population >1,000 and <3,000	Total Targets Score		39	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5		Chemical	9126	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5		Radioactive	0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 15.9	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	15.9	253	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		253		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		15.9		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		9.2		0

WORKSHEET FOR COMPUTING S_M

Facility name: TRA Acid Spill - Pit burial south of TRA-608

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis

Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Soil where about 100 gallons of spilled H_2SO_4 had been adsorbed was removed and buried in a pit. Contamination route of major concern is groundwater.

Chemical Score: $S_M = 7.1$ ($S_{gw} = 12.2$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: $S_M = 0$ ($S_{gw} =$ $S_{sw} =$ $S_a =$)

$S_{FE} =$

$S_{DC} =$

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 100 gal	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	10 / 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	30	40	
Well within 2,000' Only TRA and ICPP ~~are~~ with 3 mi. < 3,000 people	Total Targets Score		39	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		7020	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 12.2 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	12.2	149	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		149		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		12.2		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		7.1		0

WORKSHEET FOR COMPUTING S_M

Facility name: TAN/TSF Injection Well (TAN-330)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis

Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Injection well used to dispose of industrial wastewater and treated sanitary sewage. Well discharged directly to aquifer.

Chemical Score: S_M = 31.6 (S_{gw} = 54.6 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 9.2 (S_{gw} = 15.9 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	45	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
3 Containment	0 1 2 3	1		3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity ≈ 3,800 drums	0 1 2 3 4 5 6 7 8	1	6	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	7	26	
See attachment for radioactive scoring	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	24 7	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
Well within 2,000' Population < 1,000	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		31,320	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		9,135		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 54.6 Radioactive S_{gw} = 15.9				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	54.6	2981	15.9	252.8
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		2981		252.8
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		54.6		15.9
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		31.6		9.2

WORKSHEET FOR COMPUTING S_M

Scoring for Radioactive Waste Characteristics

TAN/TSF Injection Well (TAN-330)

Radioactive Maximum Potential

Group	Nuclide	Total	Cor. Coef.	Conc.(pCi/L)	Score
A	Unid Alpha	6.6×10^{-3}	20	1.3×10^{-1}	3
B	Sr-90	5.4×10^{-2}	10	5.4×10^{-1}	
	Unid β & γ	5.4×10^{-2}	100	5.4×10^{0}	
				5.9×10^{0}	7
C	Cs-134	2.9×10^{-2}	20	5.8×10^{-1}	3
D	Cs-137	1.4×10^{-1}	20	2.8×10^{0}	1
E	NONE				
F	H^3	5.3×10^{1}	100	5.3×10^{3}	3

Facility name: TAN/TSF - Radioactive Parts Security and Storage Area (RPSSA)/ TSF-1

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This area is used as a storage site for radioactively contaminated equipment. Significant contamination remains on the ground and on asphalt pad areas. Groundwater contamination is the route of primary concern.

Chemical Score: S_M = 0 (S_{gw} = 0 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 11.4(S_{gw} = 19.7 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC}

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	2	3	
	Total Route Characteristics Score		5	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	26	26	
Unknown, assume worst case					
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	0 26	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
Well within 2,000' Population <1,000					
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		0	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		11,310		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 0	Radioactive S_{gw} = 19.7			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	0	0	19.7	388
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		0		388
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		0		19.7
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		0		11.4

WORKSHEET FOR COMPUTING S_M

Facility name: TSF Disposal Pond (TAN-736)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This surface impoundment was designed to receive wastewater with low radioactivity and treated sanitary sewage. It has also received some industrial-type wastewater. The primary contamination route of concern is groundwater.

Chemical Score: S_M = 10.5 (S_{gw} = 18.1 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 3.2 (S_{gw} = 5.5 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity ≈ 1500 Drums	0 1 2 3 4 5 6 7 8	1	5	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential See attachment for radioactive scoring	0 1 3 7 11 15 21 26	1	7	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	23 7	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 1 mi but further than 2,000' Population between 101 and 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	16	40	
	Total Targets Score		25	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		10,350	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		3,150		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 18.1 Radioactive S_{gw} = 5.5				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	18.1	328	5.5	30
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		328		30
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		18.1		5.5
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		10.5		3.2

WORKSHEET FOR COMPUTING S_M

SCORING FOR RADIOACTIVE WASTE CHARACTERISTICS

TAN/TSF Disposal Pond (TAN-736)

Radioactive

Maximum Potential

Group	Nuclide	Total	Cor. Coef.	Con.(pCi/L)	Score
A	Unid Alpha	4.6×10^{-3}	20	9.2×10^{-2}	7
B	Sr 90 + 0	4.3×10^{-2}	10	4.3×10^{-1}	
	Unid β & γ	2.1×10^{-1}	100	2.1×10^{1}	
				2.1×10^{1}	7
C	Cs-134	2.6×10^{3}	20	5.2×10^{-2}	0
D	Co-60	2.0×10^{-2}	10	2.0×10^{-1}	
	Cs-137	2.7×10^{-2}	20	5.4×10^{-1}	
				7.4×10^{-1}	1
E	NONE				
F	H^3	1.1×10^{1}	100	1.1×10^{3}	1

Facility name: TAN-607 - Mercury spill outside highbay door

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis   Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

There is evidence that about 1 gallon of mercury was spilled outside the highbay door of TAN-607 and not completely cleaned-up. Groundwater contamination is the route of primary concern.

Chemical Score: S_M = 9.5 (S_{gw} = 16.4 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	18 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		9,396	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 16.4 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	16.4	268.96	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		268.96		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		16.4		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		9.5		0

WORKSHEET FOR COMPUTING S_M

Facility name: TAN-607 Fuel Spill

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

On the west side of TAN-607 an underground fuel tank (diesel fuel) was found to be leaking. About 500 gallons leaked at the time of discovery, it is unknown how much leaked before then. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 7.3 (S_{gw} = 12.7 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Diesel	0 3 6 9 12 14 18	1	12	18	
Hazardous Waste Fuel Quantity 2,050 to 12,500 gal.	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive - conservative					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	14 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population <1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		7,308	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 12.7 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	12.7	161	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		161		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		12.7		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		7.3		0

WORKSHEET FOR COMPUTING S_M

Facility name: TAN/TSF Service Station (TAN-664)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis

Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

There has undoubtedly been small spills of gasoline at the TSF Service Station. The largest identified spill was about 217 gallons. Contamination route of primary concern is groundwater.

Chemical Score: $S_M = 6.8$ ($S_{gw} = 11.8$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: $S_M = 0$ ($S_{gw} =$ $S_{sw} =$ $S_a =$)

$S_{FE} =$

$S_{DC} =$

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Gasoline	0 3 6 9 12 14 18	1	12	18	
Hazardous Waste Quantity 217 gal.	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	13 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
Well within 2,000' Population < 1,000					
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5		Chemical	6,786	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5		Radioactive	0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 11.8	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	11.8	139	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		139		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		11.8		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		6.8		0

WORKSHEET FOR COMPUTING S_M

Facility name: TAN/TSF Burn Pit

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis

Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Landfill type operation where garbage and burnable debris was disposed. Materials were set afire after each deposit. Materials included waste petroleum products generated at TAN. Contamination route of primary concern is groundwater.

Chemical Score: $S_M = 5.8$ ($S_{gw} = 10.0$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: $S_M = 0$ ($S_{gw} =$ $S_{sw} =$ $S_a =$)

$S_{FE} =$

$S_{DC} =$

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 ~~3~~	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Stoddard Solvent	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity ≈ 41 drums	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	11 / 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	20	40	
Well within 2,000' Population < 1,000					
	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		5,742	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 10.0 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	10.0	100	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		100		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		10.0		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		5.8		0

WORKSHEET FOR COMPUTING S_M

Facility name: TSF Gravel Pit

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Gravel pit northwest of TAN/TSF that has received waste, primarily construction rubble. However, there is evidence that it did receive at least one drum of chemical waste. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 3.8 (S_{gw} = 6.6 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4]					
If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 ~~3~~	1	0	3	
Permeability of the Unsaturated Zone	~~0~~ 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 ~~3~~ 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 1 drum	0 1 2 ~~3~~ 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	10 / 0	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	} ~~0~~ 4 6 ~~8~~ 10 / 12 16 18 20 / ~~24~~ 30 32 35 40	1	12	40	
Well within 1 to 2 mi					
Population < 1000					
	Total Targets Score		21	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]	Chemical		3,780	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]	Radioactive		0		
[7] Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 6.6 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	6.6	44	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		44		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		6.6		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		3.8		0

WORKSHEET FOR COMPUTING S_M

Facility name: TAN/TSF Intermediate-Level Waste Disposal System
(Tanks T-709 and T-710 or TAN-710A and 710B)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/5/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Two underground tanks used to collect radioactive wastewater and bottoms from an evaporator. The tanks are housed in concrete vaults - no evidence of leakage. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 3.4 (S_{gw} = 5.8 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 2.7 (S_{gw} = 4.6 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	1	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity ≈ 140 lbs	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	15	26	
See attachment for radioactive scoring	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	19 15	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
Well within 2000' Population < 1,000	Total Targets Score		29	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5 If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Chemical Radioactive		3,306 2,610	57,330	
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 5.8 Radioactive S_{gw} = 4.6				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	5.8	33.64	4.6	21.16
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		33.64		21.16
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		5.8		4.6
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		3.4		2.7

WORKSHEET FOR COMPUTING S_M

Scoring for Radioactive Waste Characteristics

TAN/TSF Intermediate-Level Waste Disposal System

Tanks T-709 and T-710 (TAN-710A and 710B)

Radioactive Maximum Potential

Group	Nuclide	Total	Cor. Coef.	Conc.(pCi/L)	Score
A	NONE				
B	Sr 90+D	3.4×10^{1}	10	3.4×10^{2}	15
C	Am	5.9×10^{-3}	3	1.8×10^{-2}	
	Cs-134	2.3×10^{-2}	20	4.6×10^{-1}	
	Np-237	9.2×10^{-1}	2	1.8×10^{0}	
				2.3×10^{0}	3
D	Co-60	1.0×10^{0}	10	1.0×10^{1}	
	Cs-137	4.6×10^{0}	20	9.2×10^{1}	
	Eu-154	1.9×10^{-2}	1	1.9×10^{-2}	
	Pu	1.7×10^{-2}	1	1.7×10^{-2}	
				1.0×10^{2}	7

Facility name: TAN-629 Diesel Fuel Spills, LOFT

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/6/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Fuel was overflowed to a drain pipe twice. The drain pipe leads to a ditch outside the northeast side of TAN-629. It is suspected that the diesel soaked into the ground while still in the ditch. Contamination route of primary concern is groundwater.

Chemical Score: $S_M = 7.3$ ($S_{gw} = 12.7$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: $S_M = 0$ ($S_{gw} =$ $S_{sw} =$ $S_a =$)

$S_{FE} =$

$S_{DC} =$

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4] If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Diesel Fuel	0 3 6 9 12 14 18	1	12	18	
Hazardous Waste Quantity ≈ 5,500 gal.	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	14 0	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population < 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	20	40	
	Total Targets Score		29	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]	Chemical		7,308	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]	Radioactive		0		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 12.7 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	12.7	161	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		161		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		12.7		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		7.3		0

WORKSHEET FOR COMPUTING S_M

Facility name: PBF-302, Corrosive Waste Injection Well

Location: 110 ft east of PBF-620, INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. D. Nishimoto Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

115-ft deep shallow injection well with diameter of 4 in. Depth to groundwater is 340 ft below well bottom. Used to dispose of non-radioactive chemical wastes (9,100 kg H_2SO_4, 10,500 kg NaOH, 119 kg Cr) from 1972-1978. Chromium-containing waste given maximum toxicity/persistance ranking even though it was reduced to trivalent form due to lack of supporting analytical data. Well was plugged in 1979.

Chemical Score: S_M = 12.0 (S_{gw} = 20.7 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity 21.7 Tons	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	20 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,001' to 1mi. Population 1,001 to 3,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	24	40	
	Total Targets Score		33	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		11,880	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 20.7 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	20.7	428.5	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		428.5		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		20.7		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		12.0		0

WORKSHEET FOR COMPUTING S_M

APPENDIX F

ACRONYMS

UNITS OF MEASUREMENT

Acronyms

AGCR	Army Gas-Cooled Reactor
AFSR	Argonne Fast Source Reactor
ANL-W	Argonne National Laboratory-West
ANP	Aircraft Nuclear Propulsion
ARA	Auxiliary Reactor Area
ARMF	Advanced Reactivity Measurement Facility
ARVFS	Army Re-entry Vehicle Facility Site
ATR	Advanced Test Reactor
ATRC	Advanced Test Reactor Critical
BORAX	Boiling Water Reactor Experiment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DOE-CH	Department of Energy, Chicago Operations Office
DOE-ID	Department of Energy, Idaho Operations Office
DOE-PNRO	Department of Energy, Pittsburgh Naval Reactors Office
EBOR	Experimental Beryllium Oxide Reactor
EBR	Experimental Breeder Reactor
ENICO	Exxon Nuclear Idaho Company
EOCR	Experimental Organic Cooled Reactor
EP	Extraction Procedure
EPA	Environmental Protection Agency
ETR	Engineering Test Reactor
ETRC	Engineering Test Reactor Critical
GCRE	Gas-Cooled Reactor Experiment
HEPA	High Efficiency Particulate Air (filter)
HRS	Hazard Ranking System
HTRE	Heat Transfer Reactor Experiment
ICPP	Idaho Chemical Processing Plant
IET	Initial Engine Test (Facility)

ILF	Idaho Laboratory Facility
INEL	Idaho National Engineering Laboratory
IWMIS	Industrial Waste Management Information System
LCCDA	Liquid Corrosive Chemical Disposal Area
LOCE	Loss-of-Coolant Experiment
LOFT	Loss-of-Fluid Test
LPT	Low Power Test
MHRS	Modified Hazard Ranking System
ML-1	Mobile Low Power Reactor No. 1
MSL	(Above) Mean Sea Level
MTR	Materials Testing Reactor
NOAA	National Oceanic and Atmospheric Administration
NODA	Naval Ordnance Disposal Area
NRF	Naval Reactors Facility
NRTS	National Reactor Testing Station (now the INEL)
OMRE	Organic Moderated Reactor Experiment
PBF	Power Burst Facility
PCB	Polychlorinated Biphenyl
RCRA	Resource Conservation and Recovery Act
RESL	Radiological Environmental Sciences Laboratory
RML	Radiation Measurements Laboratory
SDA	Subsurface Disposal Area
SL-1	Stationary Low Power Reactor No. 1
SNAPTRAN	Space Nuclear Auxiliary Power Transient (Program)
SPERT	Special Power Excursion Reactor Tests
STPF	Shield Test Pool Facility
TAN	Test Area North
TDA	Transuranic Disposal Area
THC	TAN Hot Cell
TRA	Test Reactor Area
TRU	Transuranic
TSA	Transuranic Storage Area
T/S/D	Treatment/Storage/Disposal (Facility)
TSF	Technical Support Facility
UOR	Unusual Occurrence Report

USGS	United States Geological Survey
WEC	Westinghouse Electric Company
WERF	Waste Experimental Reduction Facility
WINCO	Westinghouse Idaho Nuclear Company
WRRTF	Water Reactor Research Test Facility (WRRTF)
WMO	Waste Management Office
ZPR	Zero Power Reactor

UNITS OF MEASUREMENT

°C	Degrees centigrade
cc	Cubic centimeter
Ci	Curies
cfs	Cubic feet per second
cpm	Counts per minute
d	Days
°F	Degrees Fahrenheit
ft	Feet
g	Gram
gal	Gallon
gpd	Gallons per day
gpm	Gallons per minute
h	Hour
in	Inch
kg	Kilogram - 1,000 grams
kW	Kilowatt - 1,000 watts
km	Kilometer - 1,000 meters
L	Liter
m	Meter
mCi	Millicurie - 10^{-3} curies or 0.001 curies
mg	Milligram - 10^{-3} grams or 0.001 grams
mi	Mile
mL	Milliliter - 10^{-3} liters or 0.001 liters
mo	Month
mph	Miles per hour
mR	Milliroentgen
m/s	Meters per second
MW	Megawatt - 1,000,000 watts
nCi	Nanocuries - 10^{-9} curies
pCi	Picocuries - 10^{-12} curies
ppb	Parts per billion

ppm Parts per million

yd Yard (3 feet)

yr Year

μCi Microcuries - 10^{-6} curies or 0.000001 curies

Facility name: SPERT-I Corrosive Waste Seepage Pit (PBF-750)

Location: 50 ft south of PBF-604, INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. D. Nishimoto   Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Circular pit with 50-ft diameter at top and about 15 ft deep. Used from 1955-1964 to dispose of non-radioactive chemical wastes from regenerating demineralizer (1,350 kg H_2SO_4, 2,250 kg NaOH - rough estimates based on 10 regenerations/yr).

Chemical Score: S_M = 6.0 (S_{gw} = 10.4 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE}

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4]					
If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 4.0 Tons	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	10 0	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2001' to 1mi Population 1,001 to 3,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	24	40	
	Total Targets Score		33	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]	Chemical		5,940	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]	Radioactive		0		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 10.4 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	10.4	108.2		
Surface Water Route Score (S_{sw})	0	0		
Air Route Score (S_a)	0	0		
$S_{gw}^2 + S_{sw}^2 + S_a^2$		108.2		
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		10.4		
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		6.0		

WORKSHEET FOR COMPUTING S_M

Facility name: SPERT-III Small Leach Pond

Location: 100 ft north of PBF-609, INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. D. Nishimoto Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

30 x 30-ft gravel pit used from 1958-1968 to dispose of non-radioactive chemical wastes from regeneration of ion exchange resins (4,400 kg H_2SO_4, 7,700 kg NaOH - rough estimates based on 10 regenerations/yr). Backfilled and seeded in 1982.

Chemical Score: S_M = 5.0 (S_{gw} = 8.6 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC}

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1

If Observed Release is Given a Score of 45, Proceed to Line 4

If Observed Release is Given a Score of 0, Proceed to Line 2

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 13 Tons	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	11 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	16	40	
Well within 2,001' to 1 mi. Population 101 to 1,000					
	Total Targets Score		25	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		4,950	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 8.6 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	8.6	74.0	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		74.0		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		8.6		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		5.0		0

WORKSHEET FOR COMPUTING S_M

Facility name: SPERT-IV, Leach Pond (PBF-758)

Location: 270 ft south of PBF-613, INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. D. Nishimoto   Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Unlined pond, 150 x 125-ft that is currently dry and undergoing D&D characterization. Received chemical regenerant wastes (8000 kg H_2SO_4, 10,000 kg NaOH - rough estimates based on 20 demineralizer regenerations/yr) and low-level radioactive waste from 1961-1970. Pond has not been ranked for radioactive contamination due to lack of waste disposal records and anticipated low-levels of contamination in the warm waste. Re-evaluation may be required when characterization is completed.

Chemical Score: S_M = 5.0 (S_{gw} = 8.6 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 19.8 Tons	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	11 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,001' to 1mi Population 101 to 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	16	40	
	Total Targets Score		25	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		4,950	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 8.6 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	8.6	74	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		74		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		8.6		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		5.0		0

WORKSHEET FOR COMPUTING S_M

Facility name: SPERT-II Leach Pond

Location: 300 ft south of PBF-612, INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. D. Nishimoto   Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Unlined pond, 200 x 150-ft with a wetted area of about 100 x 50-ft. Used to dispose of chemical wastes (200 kg H_2SO_4, 350 kg NaOH - rough estimates based on 2 demineralizer regenerations/yr) and low-level radioactive waste from 1960-1964. Waste disposal was minimal because reactor used primarily heavy water which was recycled rather than discharged. D&D radiological characterization has shown contamination level in pond similar to background and it is therefore not ranked for radioactivity.

Chemical Score: S_M = 4.5 (S_{gw} = 7.8 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} S_{sw} S_a)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4] If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 0.6 Ton	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	10 0	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,001 to 1mi Population 101 to 1,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	16	40	
	Total Targets Score		25	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]		Chemical	4,500	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]		Radioactive	0		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 7.8 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	7.8	60.8	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		60.8		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		7.8		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		4.5		0

WORKSHEET FOR COMPUTING S_M

Facility name: PBF-301 Warm Waste Injection WEll

Location: 83 ft south of PBF-620, INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. D. Nishimoto Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Shallow injection well 110 ft deep and 10 in. in diameter. Depth to groundwater is 345 ft below bottom of well. Received low-level radioactive liquid waste from 1973-1980 (0.48 Ci total) and non-radioactive, untreated cooling water from 1972-1984. The well was sealed and capped in mid-1984.

Chemical Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 4.2 (S_{gw} = 7.3 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	7	26	
See attachment for radioactive scoring	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	0 7	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	24	40	
	Total Targets Score		33	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5		Chemical	0	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5		Radioactive	4,158		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 0	Radioactive S_{gw} = 7.3			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	0	0	7.3	53.3
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		0		53.3
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		0		7.3
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		0		4.2

WORKSHEET FOR COMPUTING S_M

Scoring for Radioactive Waste Characteristics

PBF-301 Warm Waste Injection Well

4.b Maximum Potential

Group	Nuclide	Total	Cor. Coef.	Conc.(pCi/L)	Score
A	Unid Alpha	2.2×10^{-4}	20	4.4×10^{-3}	1
B	Sr-90	1.8×10^{-3}	10	1.8×10^{-2}	
	Unid β & γ	3.3×10^{-2}	100	3.3×10^{0}	
				3.3×10^{0}	7
C	Cs-134	1.2×10^{-2}	20	2.4×10^{-1}	1
D	Co-60	1.0×10^{-3}	10	1.0×10^{-2}	
	Cs-137	3.0×10^{-1}	20	6.0×10^{0}	
				6.0×10^{0}	1
E	Np-239	3.4×10^{-3}	2	6.8×10^{-3}	0
F	Tritium	2.1×10^{-2}	100	2.1×10^{0}	0

Facility name: PBF-733 Evaporation Pond

Location: 280 ft east of PBF-620, INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: D. D. Nishimoto Date: 11/4/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

0.03-in. hypalon-lined pond 170 x 170-ft at top and 4.5-ft high earthen berms on sides. Received non-radioactive chemical wastes from 1979-1984. (7,200 kg H_2SO_4, 7,800 kg NaOH, 90 kg Cr). Discharge of hazardous chemical eliminated in 1984 when corrosive regenerant solutions were neutralized before disposal and chromates were replaced as corrosion inhibitors. Chromium waste given maximum toxicity/persistence ranking even though reduced to trivalent form due to lack of supporting analytical data.

Chemical Score: S_M = 4.0 (S_{gw} = 6.9 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	1	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity 16.6 Tons	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	20 / 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	24	40	
Well within 2,001' to 1mi Population 1,001 to 3,000					
	Total Targets Score		33	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		3,960	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 6.9	Radioactive S_{gw} = 0			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	6.9	47.6	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		47.6		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		6.9		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		4.0		0

WORKSHEET FOR COMPUTING S_M

Facility name: EOCR Leach Pond

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis

Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined surface impoundment received wastewater from the EOCR facility. Ion exchnage column regenerant appears to be the only contaminant of concern. The contamination route of major concern is groundwater.

Chemical Score: S_M = 7.1 (S_{gw} = 12.2 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity Small, operated only 2 years	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	10 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population 1,001 to 3,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	30	40	
	Total Targets Score		39	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		7,020	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 12.2 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	12.2	149	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		149		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		12.2		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		7.1		0

WORKSHEET FOR COMPUTING S_M

Facility name: OMRE Leach Pond

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined surface impoundment received radioactive wastewater from the OMRE facility. It also received some xylene which was used to clean coolant from equipment. Contamination route of major concern is groundwater.

Chemical Score: $S_M = 7.1$ ($S_{gw} = 12.2$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

Radioactive Score: $S_M = 7.8$ ($S_{gw} = 13.5$ $S_{sw} = 0$ $S_a = 0$)

$S_{FE} =$

$S_{DC} =$

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence xylene	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 355 gal.	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential *	0 1 3 7 11 15 21 26	1	11	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	10 11	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well with 2000' Population 1,001 to 3,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	30	40	
	Total Targets Score		39	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		7,020	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		7,722		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 12.2 Radioactive S_{gw} = 13.5				

* Total activity released is 2.4×10^{0} Ci. Assume worst case score as if 10% of activity is Group B. (There are no Group A discharges.) Also assume the 10% is unidentified beta and gamma. Maximum concentration is then $100 \times 2.4 \times 10^{-1} = 2.4 \times 10^{1}$ which has a score of 11. All activity could be in Group C and score no higher.

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	12.2	149	13.5	182
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		149		182
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		12.2		13.5
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		7.1		7.8

WORKSHEET FOR COMPUTING S_M

Facility name: BORAX-II - V Leach Pond

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 12/3/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

The Leach Pond used during the BORAX-II through -V programs was unlined and had an earthen bottom. It received wastewater contaminated with both chemical and radioactive constituents. Groundwater contamination is the route of major concern.

Chemical Score: S_M = 3.8 (S_{gw} = 6.6 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 2.4 (S_{gw} = 4.2 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4]					
If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 11 Tons	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	7	26	
See ~~attachment~~ for radioactive scoring	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	11 / 7	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population < 100	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	10	40	
	Total Targets Score		19	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]		Chemical	3,762	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]		Radioactive	2,394		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 6.6	Radioactive S_{gw} = 4.2			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	6.6	43.56	4.2	17.64
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		43.56		17.64
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		6.6		4.2
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		3.8		2.4

WORKSHEET FOR COMPUTING S_M

Score for Radioactive Waste Characteristics

BORAX-II - V Leach Pond

4.b Max Potential

Group	Nuclide	Total	Cor. Coef.	Conc.(pCi/L)	Score
A	Unid Alpha	1.3×10^{-3}	20	2.6×10^{-2}	3
B	Sr-90	5.4×10^{-5}	10	5.4×10^{-4}	
	Unid Beta	1.1×10^{-2}	100	1.1×10^{0}	
				1.1×10^{0}	7
C	NONE				
D	Co-60	4.5×10^{-3}	10	4.5×10^{-2}	
	Cs-137	3.2×10^{-2}	20	6.4×10^{-1}	
	Pu-239, 240	9.1×10^{-6}	1	9.1×10^{-6}	
	U-234	2.6×10^{-4}	20	5.2×10^{-3}	
	U-235	1.0×10^{-5}	20	2.0×10^{-4}	
	U=238	2.5×10^{-4}	20	5.0×10^{-3}	
				6.4×10^{-1}	0
E	NONE				
F	NONE				

Facility name: BORAX-I Burial Site

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined waste pile area was used to dispose of radioactive contaminated materials from the old BORAX-I facility. Activity is estimated from limited soil samples. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 0 (S_{gw} = 0 S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 2.5 (S_{gw} = 4.4 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4] If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	2	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	11	26	
See attachment for radioactive scoring	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	0 11	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	10	40	
Well within 2000' Population < 100					
	Total Targets Score		19	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]	Chemical		0	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]	Radioactive		2,508		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 0		Radioactive S_{gw} = 4.4		

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})				
Surface Water Route Score (S_{sw})	0	0	4.4	19.4
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		0		19.4
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		0		4.4
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		0		2.5

WORKSHEET FOR COMPUTING S_M

Scoring for Radioactive Waste Characteristics

BORAX-I Burial Site

Radioactive Maximum Potential

Group	Nuclide	Total	Cor. Coef.	Conc.(pCi/L)	Score
A	Unid Alpha	$\sim 1.5 \times 10^{-1}$	20	3.0×10^{0}	11
B	Unid Beta	$\sim 1.5 \times 10^{-1}$	100	1.5×10^{1}	
	Sr-90	1.4×10^{-2}	10	1.4×10^{-1}	
				1.5×10^{1}	7
C	NONE				
D	Cs-137	3.7×10^{1}	20	7.4×10^{2}	
	U-235	7.3×10^{-1}	20	1.5×10^{1}	
				7.6×10^{2}	7
E	NONE				
F	NONE				

Facility name: Liquid Chemical Corrosive Disposal Area (LCCDA)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

The LCCDA consisted of two unlined pits or surface impoundments. Corrosive chemicals have been dumped in each. Contamination route of major concern is groundwater.

Chemical Score: S_M = 3.7 (S_{gw} = 6.4 S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity ≈ 15,500 gal	0 1 2 3 4 5 6 7 8	1	3	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	12 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' to 1 mi. Population < 100	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	8	40	
	Total Targets Score		17	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		3,672	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 6.4 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	6.4	41	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		41		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		6.4		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		3.7		0

WORKSHEET FOR COMPUTING S_M

Facility name: Naval Ordrance Disposal Area (NODA)

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This open dirt area was once used as a storage site for hazardous waste.

There is evidence that some of the materials may have spilled or leaked.

Contamination route of primary concern is groundwater.

Chemical Score: S_M = 5.9 (S_{gw} = 10.2 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Methylene	0 3 6 9 12 14 18	1	12	18	
Hazardous Waste Chloride Quantity 1 to 40 drums	0 1 2 3 4 5 6 7 8	1	1	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	13 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2 to 3 mi Population 3,001 to 10,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	16	40	
	Total Targets Score		25	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		5,850	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 10.2 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	10.2	104.04	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		104.04		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		10.2		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		5.9		0

WORKSHEET FOR COMPUTING S_M

Facility name: CFA Landfill

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

The old CFA landfill is unlined and is known to have accepted hazardous waste in the past. Quantities are based on known or recorded entries and known waste products. Contamination route of major concern is groundwater.

Chemical Score: S_M = 17.7 (S_{gw} = 30.6 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence Chrome	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity 150 drums/yr + asbestos	0 1 2 3 4 5 6 7 8	1	7	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	25 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well within 2,000' Population 1,001 to 3,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	30	40	
	Total Targets Score		39	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		17,550	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 30.6 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	30.6	936	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		936		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		30.6		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		17.7		0

WORKSHEET FOR COMPUTING S_M

Facility name: CF-674 Pond

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 12/3/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined seepage pond received wastewater from fuel processing pilot plant operations. Quantities and types of hazardous waste going to the pond are unknown, but mercury appears to be the most hazardous of the suspect materials. For estimating purposes, 11 to 62 tons of hazardous constituents going to the pond should be conservative since it was always a small scale operation. Natural uranium is suspected to be present, but since hand surveys of the pond show no detectable activity, the site has not been ranked for radioactivity.

Chemical Score: S_M = 12.0 (S_{gw} = 20.7 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical a. Toxicity/Persistence Mercury	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity 11 to 62 Tons	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	20 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served Well with 2001' to 1 mi. Population 1,001 to 3,000	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	24	40	
	Total Targets Score		33	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		11,880	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 20.7 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	20.7	428.49	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		428.49		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		20.7		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		12.0		0

WORKSHEET FOR COMPUTING S_M

Facility name: CFA Motor Pool Pond

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis   Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This unlined surface impoundment received wastewater from the equipment repair facility. Contamination route of primary concern is groundwater.

Chemical Score: S_M = 8.5 (S_{gw} = 14.7 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Ground Water Route Work Sheet

Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4 If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence H_2SO_4	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity 15,000 gal	0 1 2 3 4 5 6 7 8	1	3	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	0	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	12 0	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	30	40	
Well within 2,000' Population 1,000 to 3,000	Total Targets Score		39	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		8,424	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		0		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 14.7 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	14.7	216.09	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		216.09		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		14.7		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		8.5		0

WORKSHEET FOR COMPUTING S_M

Facility name: CFA Sewage Drainage Field

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

This subsurface drainage field accepts treated sanitary sewage but includes radioactive contaminated wastewater from the CFA laundry.

Chemical Score: S_M = 0 (S_{gw} = 0 S_{sw} = S_a =)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 7.8 (S_{gw} = 13.5 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	11	26	
See attachment for radioactive scoring					
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. / 4b.	0 / 11	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	30	40	
Well within 2,000' Population 1,001 to 3,000					
	Total Targets Score		39	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		0	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		7,722		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 0	Radioactive S_{gw} = 13.5			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	0	0	13.5	182
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		0		182
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		0		13.5
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		0		7.8

WORKSHEET FOR COMPUTING S_M

Score for Radioactive Waste Characteristics

CFA Sewage Drainage Field

Radioactivity Maximum Potential

Group	Nuclide	Total	Cor. Coef.	Conc.(pCi/L)	Score
A	Unid Alpha	2.6×10^{-2}	20	5.2×10^{-1}	7
B	Sr 90 + D	3.1×10^{-1}	10	3.1×10^{0}	11
	Unid β & γ	1.3×10^{0}	100	1.3×10^{2}	
				1.3×10^{2}	
C	Cs-134	4.8×10^{-3}	20	9.6×10^{-2}	0
D	Co-60	5.7×10^{-2}	10	5.7×10^{-1}	0
	Cs-137	8.8×10^{-2}	20	1.7×10^{0}	
	Eu-152	4.4×10^{-5}	1	4.4×10^{-5}	
				2.3×10^{0}	
E	Sb-125	1.2×10^{-4}	20	2.4×10^{-3}	0
F	H^3	2.7×10^{1}	100	2.7×10^{3}	1

Facility name: CF-633 French Drain

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: K. D. Davis

Date: 12/3/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Subsurface french drain on the east side of the building has received laboratory wastewaters, probably with small quantities of acids, bases, radionuclides, xylene and toluene. Quantities are unknown, but it is assumed that 11 to 62 tons of hazardous constituents is a conservative estimate.

Chemical Score: S_M = 7.8 (S_{gw} = 13.5 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

Radioactive Score: S_M = 0 (S_{gw} = S_{sw} = S_a =)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line [4] If Observed Release is Given a Score of 0, Proceed to Line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence xylene	0 3 6 9 12 14 18	1	9	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	2	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential*	0 1 3 7 11 15 21 26	1	0	26	
* Only 4.6 x10^{-3} pCi/L of Group B	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	11 0	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	30	40	
Well within 2,000' Population 1,001 to 3,000	Total Targets Score		39	49	
[6] If Line [1] is 45, Multiply [1] x [4] x [5]	Chemical		7,722	57,330	
If Line [1] is 0, Multiply [2] x [3] x [4] x [5]	Radioactive		0		
[7] Divide Line [6] by 57,330 and Multiply by 100	Chemical S_{gw} = 13.5 Radioactive S_{gw} = 0				

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	13.5	182.25	0	0
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		182.25		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		13.5		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		7.8		0

WORKSHEET FOR COMPUTING S_M

Facility name: Radioactive Waste Management Complex

Location: INEL

EPA Region: X

Person(s) in charge of the facility: EG&G Idaho, Inc.

Name of Reviewer: P. S. Fridlund Date: 11/7/85

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Trenches, pits, vaults, storage pads. Wastes in drums, boxes, or other containers. Burial procedrues range from simple dumping and covering with earth to specific container arrangements with plywood & polyvinal layering. The facility is designed for low-level radioactive wastes, but radioactive hazardous mixed wastes are suspected. See attachment for ranking justification.

Chemical Score: S_M = 9.0 (S_{gw} = 15.5 S_{sw} = 0 S_a = 0)

S_{FE}

S_{DC} =

Radioactive Score: S_M = 9.0 (S_{gw} = 15.5 S_{sw} = 0 S_a = 0)

S_{FE} =

S_{DC} =

GROUND WATER ROUTE WORK SHEET

Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If Observed Release is Given a Score of 45, Proceed to Line 4					
If Observed Release is Given a Score of 0, Proceed to Line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	0	6	
Net Precipitation	0 1 2 3	1	0	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	3	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		6	15	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Chemical					
a. Toxicity/Persistence	0 3 6 9 12 14 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	8	8	
Radioactive					
b.1 Maximum Observed	0 1 3 7 11 15 21 26	1	0	26	
b.2 Maximum Potential	0 1 3 7 11 15 21 26	1	26	26	
	Total Waste Characteristics Score (Largest of 4a, b.1, b.2)	4a. 4b.	26 26	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	10	40	
	Total Targets Score		19	49	
6 If Line 1 is 45, Multiply 1 x 4 x 5	Chemical		8,892	57,330	
If Line 1 is 0, Multiply 2 x 3 x 4 x 5	Radioactive		8,892		
7 Divide Line 6 by 57,330 and Multiply by 100	Chemical S_{gw} = 15.5	Radioactive S_{gw} = 15.5			

	Chemical		Radioactive	
	S	S^2	S	S^2
Groundwater Route Score (S_{gw})	15.5	240.25	15.5	240.25
Surface Water Route Score (S_{sw})	0	0	0	0
Air Route Score (S_a)	0	0	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		240.25		240.25
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		15.5		15.5
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		9.0		9.0

WORKSHEET FOR COMPUTING S_M

GROUNDWATER

1. 0 No observed releases of either radioactive or hazardous chemical waste.

2. 0 Depth to aquifer is greater than 150 feet.

 0 Net precipitation is less than -10 inches per year.

 3 Permeability of unsaturated zone--trenches and pits scraped down to fractured basalt layer.

 3 Some liquid and some gas waste present.

3. 3 Adequate system of diking, but containers have been found leaking although no release can be justified using the ranking system.

4. 18 Waste characteristics calculated as follows: 3 for persistence because there are metals such as mercury and lead buried at RWMC and there are polychlorinated biphenyls present in the waste as well; 3 for toxicity because an Unusual Occurrence Report indicates that there is cyanamide/cyanide poison buried at the site.

 8 Assume worst case (>10,000 barrels) because there is no way to tell how much hazardous waste is buried at the RWMC.

 26 For radioactive waste assume worst case since not all the radionuclides present are listed in the ranking system tables and charts.

5. 3 Groundwater is used by RWMC personnel because no other water is available.

 10 Estimated that the nearest wall is within 2000 feet of the waste (chart value of 4), and serves less than 100 people (chart value of 1).

SURFACE WATER

1. 0 No observed releases of either radioactive or hazardous chemical wastes.

2. 0 Facility slop and intervening terrain has average slope of 3% or less and slightly higher elevations between site and water body (RWMC is located in a slight depression).

   1 1-yr. 24-hr. rainfall is 1-2 inches.

   1 1-2 miles to nearest surface water (Big Lost River).

   3 Some liquid and some gas waste present.

3. 0 Adequate system of diking exists but there is evidence of leaking containers, although no release has been observed that would qualify for ranking.

4. 18 Waste characteristics calculated as follows: 3 for persistence because there are metals such as mercury and lead buried at RWMC and there are polychlorinated biphenyls present in the waste as well; 3 for toxicity because an Unusual Occurrence Report indicates that there is cyanamide/cyanide poison buried at the site.

   8 Assume worst case (>10,000 barrels) because there is no way to tell how much hazardous waste is buried at the RWMC.

   26 For radioactive case, assume worst case since not all the radionuclides resent are listed in the various ranking charts and tables.

5. 0 Closest surface water is the Big Lost River and it is not used for anything within a three mile radius of RWMC.

   0 There is no sensitive environment near the RWMC.

   0 The population served is less than 100 people which are 1-2 miles from the Big Lost River, however, since the surface water is not used for anything it must be given a zero.

AIR ROUTE

1. 0 No significant amount above background could be observed for either radioactive or hazardous chemical wastes.

Since above is 0, there is no need to proceed farther.